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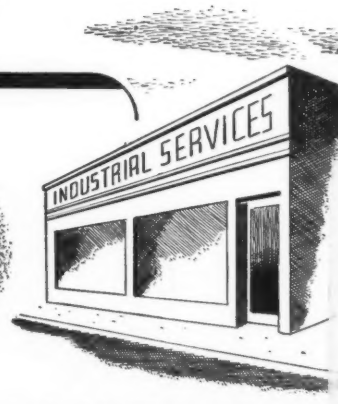

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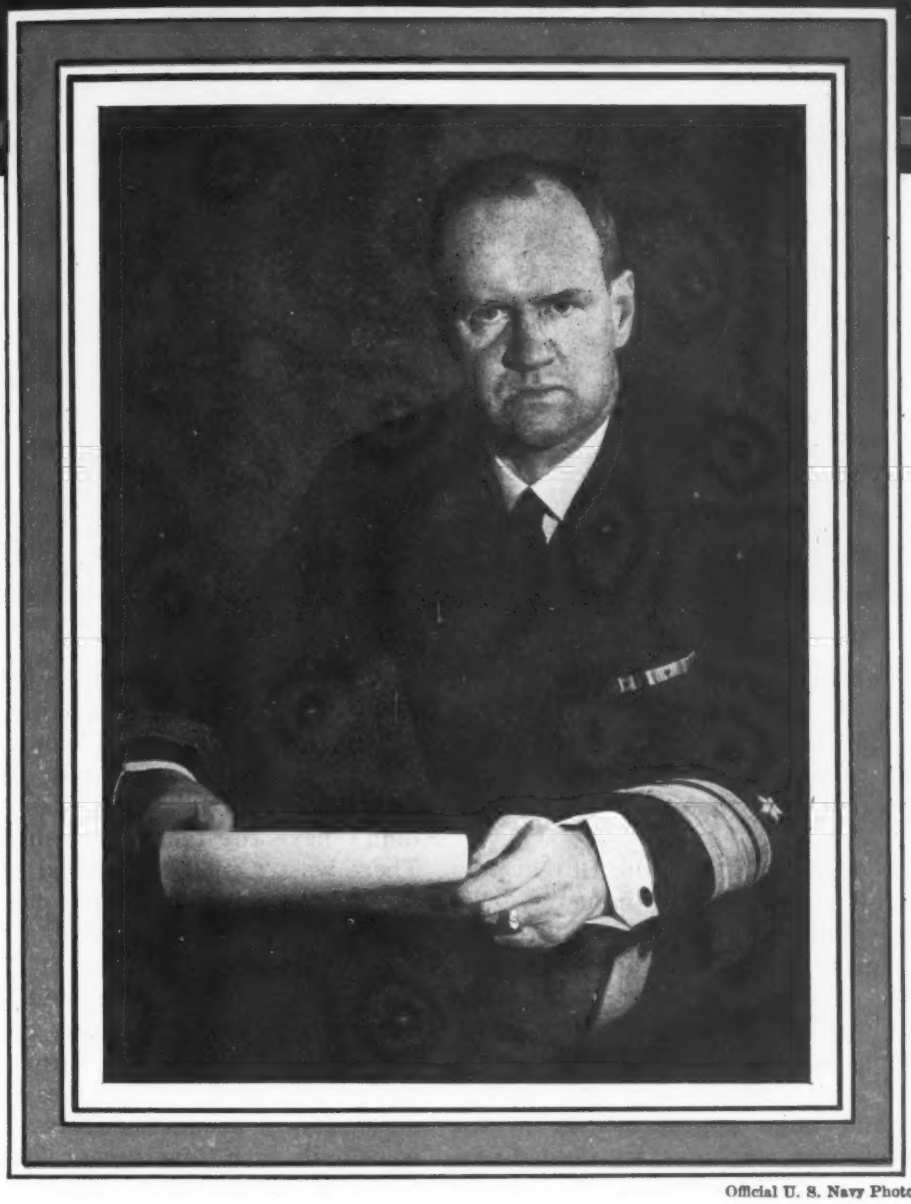
Volume 51 No. 4 MACHINERY DECEMBER 1944



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Industry's Phenomenal Achievement

By REAR ADMIRAL GEORGE F. HUSSEY, JR. (U.S.N.)
Chief, Bureau of Ordnance, United States Navy Department

WHEN the Japanese made their attack on Pearl Harbor three years ago this month, the Bureau of Ordnance was facing a gigantic task. The Fleet was still in the process of being re-armed to meet the conditions of modern war, while at the same time, armament was being supplied for an almost unbelievable number of new planes and ships.

The immensity of the problem is seen more clearly when you start enumerating the items that had to be supplied. Ordnance is our means of smashing the enemy. It is everything we throw at him, weapons with which we throw it, devices to control our aim, and our means of parrying his thrusts. It includes guns, projectiles, bombs, armor, rockets, mines, torpedoes,

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fire-control instruments, and similar equipment. It provides the essential fighting qualities, other than speed and structural strength, of every craft we send to sea—whether it flies through the air or travels on the surface or beneath the surface.

To fulfill its responsibilities, the Bureau had to have the full cooperation of industry. We could make the plans, outline the procedure, and direct the program, but it was up to industry to produce the goods. The way industry has accepted its share of the responsibility is revealed in its phenomenal accomplishments.

In order to meet enemies who had devoted many years and huge appropriations to the building of their war machines, we needed new weapons and revisions of old ones. We needed them in great quantities. To produce these quantities we had to have technical knowledge, specialized facilities, trained personnel, and large supplies of raw materials.

Technical knowledge—the "know how" of ordnance manufacture—was scarce. During the years of peace, makers of munitions had become characters of ill repute—were regarded as men who fostered war for personal gain. With the exception of a few private manufacturers who supplied small quantities of standard ammunition, technical knowledge of naval ordnance production was confined to the Naval Gun Factory in the Washington Navy Yard and the Newport, R. I., Torpedo Station, which had supplied guns and torpedoes for the peacetime Navy.

This knowledge could not be spread thin enough to meet the demands. War engineering talent in private industry was only latent. We didn't have the tools for ordnance production. There wasn't enough material to go around. In short, industry didn't know how to make ordnance, there wasn't anything with which to make it or anyone to make it.

In spite of all this, absolute miracles of production have been performed. Commercial plants that had been turning out automobiles, ice boxes, radios, and washing machines were wholly converted to war production. Naval Ordnance plants were built with Government funds and operated under a commanding officer by a contractor-operator. Industry cooperated with the Navy in filling impossible schedules. And industry cooperated with industry. Competitors were eagerly exchanging carefully guarded trade secrets—to win the war.

Industry as a whole deserves full credit, but some special consideration is due the manufacturers of machine tools, whose early production made possible record conversions from the goods of peace to the weapons of war.

Research and development form one of the most important ordnance activities. However, it is one thing for scientists to dream up a new device and for skilled technicians to make a

model, but a much different thing to put it into mass production. In making these new developments effective, we have seen one of the outstanding features of the war in a full utilization of the combined talents of American science, industry, and the military forces.

Events of the war, even before our own entry into it, clearly indicated the need for a stronger "close range" defense than anyone had previously considered necessary. We had effective heavy guns on most of our ships, and we had the 1.1-inch and 0.50-caliber machine guns, but they were too light for the modern dive bomber and torpedo plane. We didn't have the time to design new guns, so we had to look into foreign fields. We came out with the 40-millimeter Bofors—a Swedish gun—and the 20-millimeter Oerlikon, of Swiss design.

But the purchase of manufacturing rights for these excellent guns was merely the first chapter of the story. We still had to translate foreign blueprints for American use; industry had to learn the close tolerances that the manufacture of their parts required; we had to design and develop improved ammunition, different mounts to suit our varied demands, gunsights, and directors—and we had to have them in great quantity. The success of the program is obvious when it is considered that in little more than a year after Pearl Harbor our ships were throwing up more than sixty times as much anti-aircraft fire as previously.

Admiral Hussey says, "It is one thing for scientists to dream up a new device and for skilled technicians to make a model, but a much different thing to put it into mass production." Articles presented in this number of MACHINERY deal with processes developed in ordnance plants operated by private industry to perform the miracles of production which have aided the Navy in winning the war — processes that will be fully as applicable in the manufacture of peacetime products in the post-war period.

The need for research and development in ordnance continues. Every improvement that can be made will speed the day of final victory and save the lives of American fighters and their Allies. The cost of our victory at Tarawa was great because the Japanese fortifications withstood the preparatory bombardment. As soon as the island was secure, ordnance officers went ashore and collected first-hand data on what had happened. Sifting of this information was followed by a series of tests of our ammunition in various combinations against replicas of the Jap fortifications. The results were in the hands of the Fleet in time for Kwajalein. Bombardment ammunition worth some $10,000,000 was expended in that operation—and the losses were about one-twelfth those of Tarawa. Each new landing has furnished additional knowledge for improving naval ordnance.

Cooperation is firing the Fleet's guns in a constantly increasing tempo. Science, industry, labor, management, and the armed forces are working as a team to hit the enemy again and again. They've combined American ingenuity with an unfaltering "will to win" to give our fighting men the world's best weapons.

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★ Precision Electric
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Hardening of Ordnance Parts ★

Induction Hardening Operations Performed with Great Accuracy by Northern Ordnance, Inc. – a Concern that Has a Reputation for Workmanship of the Highest Order

By CHARLES O. HERB

BEFORE the present war, the Northern Pump Co., Minneapolis, Minn., conducted a profitable business in the manufacture of a large variety of pumps—cargo, fuel, impeller, fire, and hydraulic pumps of precision rotary, radial-piston, axial-parallel-piston, and other types. The line included pumps for delivering as little as one gallon per hour and as much as five thousand gallons per minute. Pumps that operate at pressures as high as 4000 pounds per square inch were regular products. The concern also specialized in the production of hydraulic motors and controls.

This manufacturing experience prepared the company for an important part in wartime production, particularly since it was capable of producing the highly accurate hydraulic controls that have made our single and twin 5-inch naval gun mounts so effective. Since the beginning of the war, the concern has specialized in the manufacture of such controls, and it also builds the gun mounts themselves, complete except for the gun. Among other ordnance, the company produces powder and projectile hoists.

From a comparatively small enterprise the concern has become, during this war, the biggest producer of naval ordnance machinery in the country. Its manufacturing facilities have been widely expanded by the Navy Department. Since the middle of 1942, the war business of this company, which represents 99 per cent of the present annual volume, has been conducted under the name of Northern Ordnance, Inc.

Because of the high grade of workmanship put into the products through the use of the latest types of machine tools and methods, this shop is considered one of the finest in the world. There are, therefore, many operations and processes of unusual interest carried out there. This article will deal with induction hardening, which was adopted to insure uniform heat-treatment of a variety of parts without loss of dimensional accuracy.

By the application of induction hardening the wearing surfaces of the internal teeth in the large training circles for naval gun mounts are uniformly hardened to a scleroscope reading of from 55 to 60 without any distortion of the tooth form. After being hardened, the outside diameter of these rings must be 114 inches within plus nothing minus 0.002 inch. The rings are taken right from the hardening machine to the assembly floor without subsequent finishing. The rings shrink 0.009 inch in diameter during the heat-treating operation, and are therefore finished that much over size before they go to the heat-treating department.

Hardening of the teeth in these training circles is performed with the special equipment shown in the heading illustration, which was built by Northern Ordnance, Inc. This unit receives electric current from a standard three-station Tocco Junior machine which is seen at the left in Fig. 1. Current is supplied at 9600 cycles by the 125-kilowatt motor-generator set of this machine. The special gear hardening

unit consists essentially of a heating coil or inductor and a current transformer, which are assembled together as seen in Fig. 2. They are arranged on a slide which automatically rises and descends between indexings of the training circle, so that the inductor can be placed automatically over the successive teeth for heating them to the required temperature.

Automatic indexing of the training circle is accomplished by means of a pneumatically operated device seen at the left in Fig. 2, in which is incorporated a piston to which a dog is attached. When a gear tooth has been heated as required, the pneumatic piston is pulled back until the dog is registered against the back of the gear tooth following the one that it has been in contact with. Then the piston is moved forward, causing the dog to push the gear tooth forward against a stop. The dog is backed up by a spring which is depressed to allow the dog to move past the gear teeth with each backward movement of the piston. Also, the stop is hinged so as to release the gear teeth prior to each indexing. The movements of the inductor and the air valves of the pneumatic device are controlled by a motor-driven cam.

For hardening a complete gear, the operator merely depresses a switch button, after which the operation proceeds automatically until all 108 teeth have been hardened. This is accomplished in a floor-to-floor time of only 32 minutes, whereas 3 1/2 hours was required by the hardening method previously employed. The heating time for each tooth is only 10 seconds. Current for heating the teeth by induction is passed through the single-turn inductor. The bars of the inductor are spaced to provide a limited amount of clearance between them and the teeth.

The training circle teeth are approximately 1 1/4 inches thick at the pitch line by 5 inches wide. They are hardened to a depth of about 0.100 inch, on the wearing surfaces only. In the operation, the temperature of the tooth surface is raised to 1750 degrees F. As these training circles are made of S A E 4340 steel, which is air-hardening, the customary water quench used in the Tocco process is not required in this instance.

The outstanding advantage of this operation is the hardness uniformity obtained without relying on the human element. Since hardness

Fig. 1. Induction Hardening the Training Circle for a Gun Mount where the Composition of the Steel Requires Water Quenching

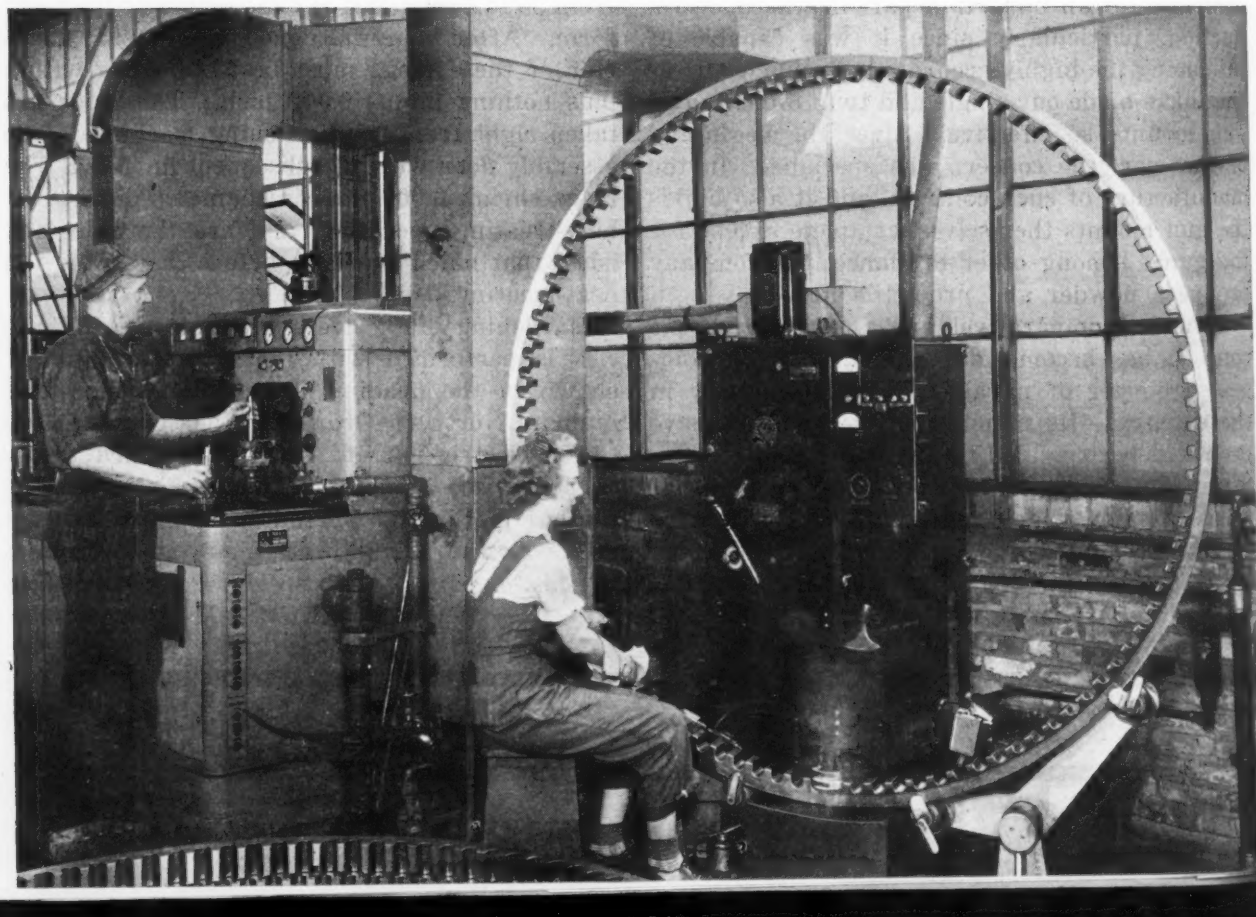

Fig. 2. Close-up View of the Induction Hardening Operation Seen in the Heading Illustration, Showing the Inductor, Transformer, and Indexing and Locating Mechanism

does not depend upon the accuracy of an operator's eye in checking colors, an unskilled man or girl can operate the equipment that hardens these precision gears. The power output is 90 kilowatts.

Training circles for a smaller gun mount are made of a water-hardening, low-carbon alloy steel, and are therefore handled somewhat differently. The auxiliary unit employed for the smaller training circle is shown in Fig. 1. This equipment also is supplied with electric current by the Tocco machine. Fig. 3 shows a close-up view of the combined inductor and quenching chamber.

This operation is also automatic from the moment a push-button is depressed to start heating a tooth until the last tooth has been hardened. Indexing and tooth locating, however, are effected somewhat differently than on the unit that handles the larger training circles. A pneumatic cylinder and piston at the left of the unit perform the indexing, as on the machine already described, but a device at the right locates the teeth for the successive steps of the operation. This device consists essentially of a ball-bearing detent that enters the space between successive teeth.

The teeth of these smaller training gears are raised to a temperature of 1650 degrees F. in a heating period of four seconds. There is then a time delay of 0.6 second, after which water is sprayed from holes in the inductor bars for a period of one second. All 103 teeth of this ring are hardened in 18 minutes. The floor-to-floor

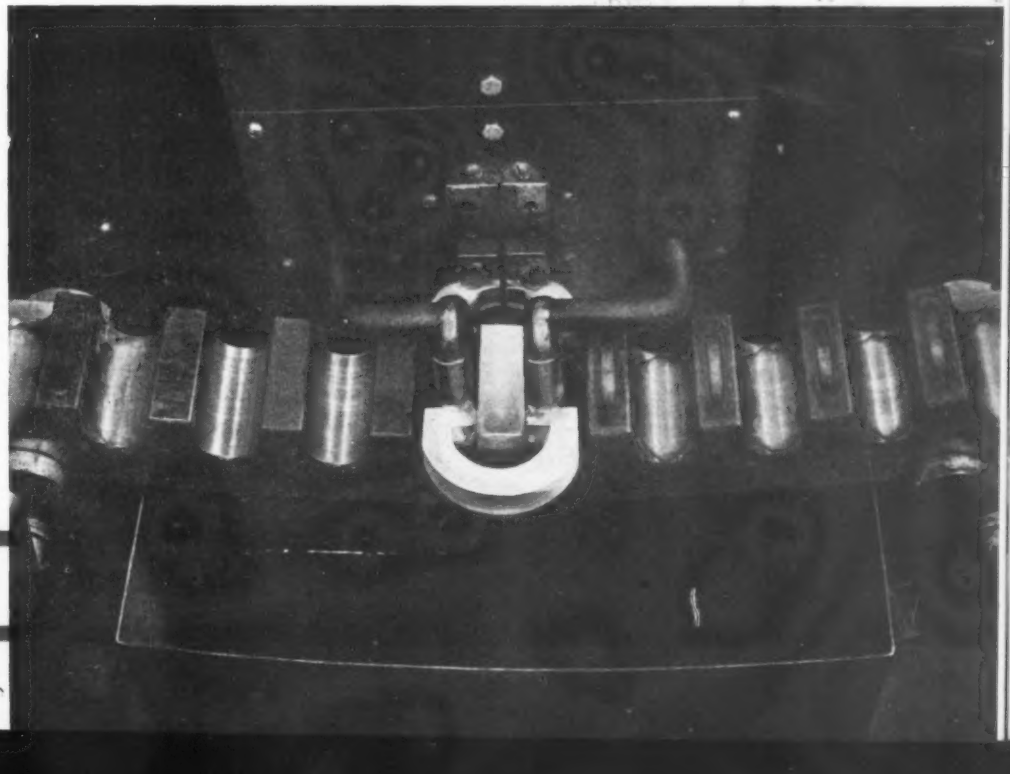

Fig. 3. Close-up View of the Inductor Used on the Machine Seen in Fig. 1, Showing the Arrangement for Water Quenching

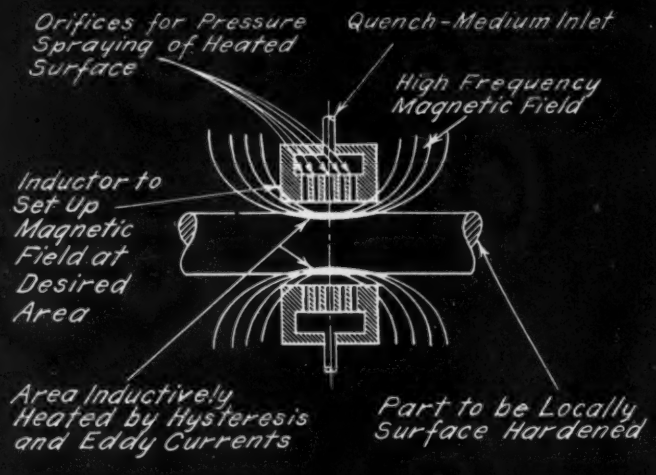
Orifices for Pressure Spraying of Heated Surface
Quench-Medium Inlet
High Frequency Magnetic Field
Inductor to Set Up Magnetic Field at Desired Area
Area Inductively Heated by Hysteresis and Eddy Currents
Part to be Locally Surface Hardened

Fig. 4. Diagram that Indicates the Principle of Induction Hardening and Points out the Area Inductively Heated by Hysteresis and Eddy Currents

Fig. 5. Special Machine Devised for Induction Hardening Bearing Rollers 1 1/2 Inches in Diameter by 2 Inches Long at the Rate of 1300 per Hour

time, which allows for hardness inspection, is 25 minutes. This compares very advantageously with the 2 1/2 hours required by the method previously in use.

As a matter of fact, because of the low carbon content in the steel from which these training circles are made, it was found impossible to heat-treat them satisfactorily until induction hardening was adopted. The tooth wearing surfaces of these training circles are also hardened to a scleroscope reading of between 55 and 60.

Water for quenching is delivered to the teeth under pressure from both sides of the inductor through holes 1/16 inch in diameter. There are about fifty of these holes on each side of the inductor. The diametrical accuracy of these training circles is fully as important as that of the larger training circles. The power output in the hardening is 66 kilowatts.

This hardening operation is based completely on the underlying principles of the Tocco process, in which a material capable of conducting electric current is placed within a magnetic field that is set up by an inductor carrying an electric current, and thus becomes heated. Efficient heating is accomplished by the use of high-frequency current. When a magnetic material like steel is placed within such a field, as shown diagrammatically in Fig. 4, the molecules of the steel attempt to align themselves with the polarity of the field. With such a change occurring thousands of times per second, an enormous amount of internal molecular friction is developed as a result of the natural tendency for the steel to resist the changes. The electric energy is, therefore, transformed into heat through the medium of friction.

The frictional action producing the heat is called hysteresis, and obviously is dependent upon the magnetic qualities of the steel. Thus when the temperature has passed the critical point at which the steel becomes non-magnetic, hysteretic heat ceases. Although hysteresis must be considered as being present, the amount of heat produced by it is probably of negligible importance. Non-magnetic materials, such as carbon, aluminum, and copper, respond readily to induction heating, as do also non-magnetic steels.

Of major importance is the source of heat due

Fig. 6. Special Unit Developed for Use on a Tocco Machine for Induction Hardening All of the Teeth in a Spur Gear of 9 1/2 Inches Outside Diameter

to eddy currents, which occur as a result of the magnetic flux changes, much the same as eddy swirls in a rapidly moving stream of water. With the resistance of the steel increasing with increase in temperature, the intensity of the eddy current decreases, and when the proper quenching temperature is reached, it is only a fraction of its original "cold" value. However, since another inherent characteristic of high-frequency current is to concentrate on the surface of its conductor, the surface layers become heated first. This phenomenon, called "skin effect," is a function of the electric frequency. Other things being equal, the higher the frequency, the shallower the depths of penetration.

As mentioned, when the temperature of an inductively heated steel bar arrives at the critical point, all heating due to hysteresis ceases, but that due to eddy currents continues at a greatly reduced rate. Since the entire action goes on within the surface layers, only that portion of the work is affected. The original properties of the core can be maintained and surface hardness obtained by quenching after complete carbide solution has been attained.

Continued application of power causes an increase in the depth of heating, because as each layer of steel is brought up to temperature, the current density shifts to the layer beneath, which offers a lower resistance. Selection of the proper frequency and control of the power and the heating time make possible the attainment of any desired specifications of surface hardening or "through heating" for heat-treating, annealing, normalizing, brazing, forging, or forming operations.

Another important induction hardening operation developed by Northern Ordnance, Inc., consists of hardening the bearing rollers on which the gun mounts revolve. These bearing rollers are used both vertically and horizontally. They support the entire weight of the gun mount, with the exception of the base. The rollers are made of S A E 52100 chromium steel which is produced in electric furnaces. They are 1 1/2 inches in diameter by 2 inches long and 7/8 inch in diameter by 1 3/8 inches long. In both cases, the diameter must be held within plus 0.0002 inch minus 0.0002 inch. Before assembly, the rollers are sorted by inspectors in increments of 0.0002 inch.

The larger bearing rollers are hardened at the rate of 1300 an hour so uniformly that rejection due to improper hardness is nil. The operation is performed without any scale on the roller. The rollers are hardened to from 60 to 62 Rockwell C on the external surfaces and to approximately 55 Rockwell C at the center.

High production has been attained in this operation through the provision of a conveyor-fed machine of vertical design, which is illustrated in Fig. 5. A girl operator loads the rollers on brackets attached to a canvas belt. This belt carries the rollers to a hopper at the top of the machine, which surrounds the upper end of a vertical asbestos tube. From the hopper the

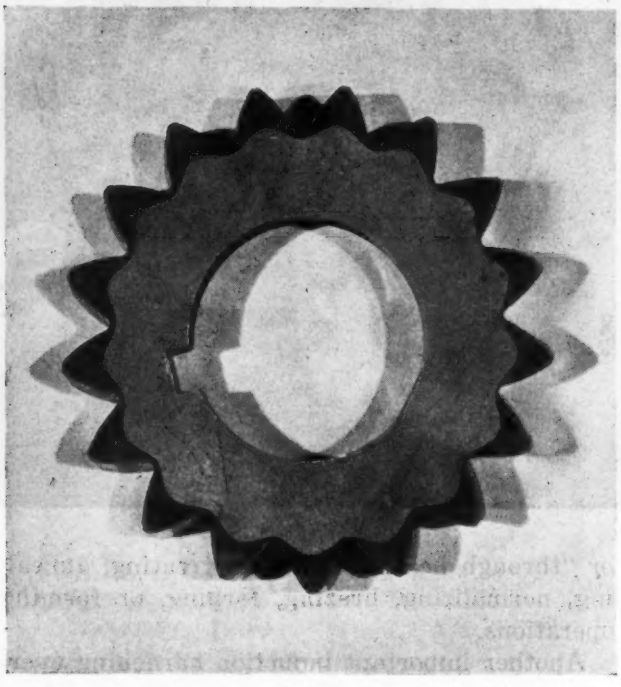

Fig. 7. Macrostructure of an Induction Hardened Sprocket that Shows Full Hardness from the Tip of the Teeth to the Pitch Diameter

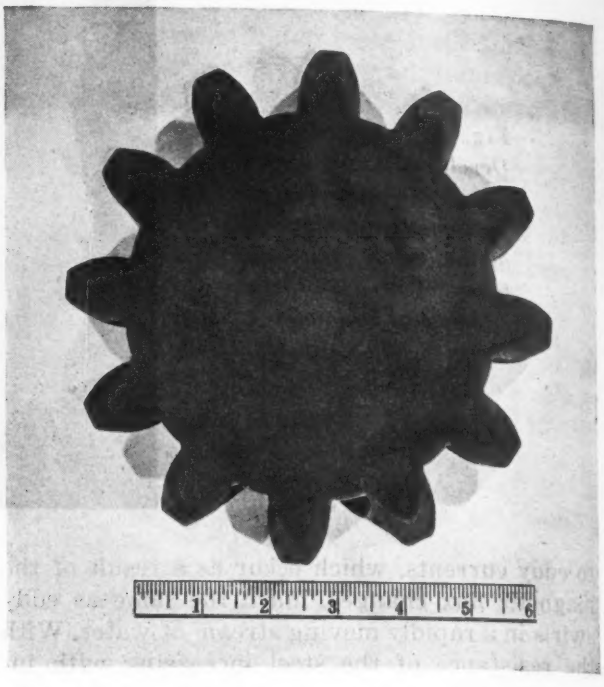

Fig. 8. Macrostructure of a Gear that Indicates Hardened Area on All Working Surfaces of the Teeth and a Tough Core within the Hardened Area

rollers slide vertically into this tube and ride one upon the other, forming in effect, a continuous bar of steel which moves to the bottom of the unit. The movement of this column of rollers is retarded to the proper rate by a motor-driven cam in a drive near the floor.

Surrounding the asbestos tube is a copper heating coil of 76 turns which carries 132 kilowatts of the 9600-cycle electric current supplied by the Tocco machine. This coil provides a heating chamber about 4 feet long. As the rollers pass through this chamber they attain a surface temperature of 1600 degrees F. The rollers then enter a soaking chamber, about 15 inches long. Next they pass into a quenching chamber 12 inches long. This quenching chamber has an inside diameter 1/4 inch larger than the diameter of the bearing rollers, so as to permit a wall of water 1/8 inch thick to completely surround the rollers. This water quench reduces the roller temperature to 450 degrees F.

When the rollers are permitted to drop from this quenching chamber into a box at the rate of one per revolution of the cam, or twenty-one a minute, they have been hardened within the required limits. They are self-drawn or stress-relieved because of the residual heat. The purpose of the asbestos tube within the heating coil is to prevent the rollers from actually contacting the coil and causing short circuits. In addition to the uniformity of hardening, an outstanding advantage of this hardening method is its cleanliness.

In back of the hardening machine for the larger bearing rollers, as seen in Fig. 5, is somewhat similar equipment for handling the smaller bearing rollers. In this instance, however, the rollers are shovelled into a mechanical hopper which ejects them into a tube, through which they are pushed to the top end of a heating coil. These rollers are hardened at the rate of 4600 per hour, or 76 a minute.

When the bearing rollers were hardened by the method formerly in use, they had to be loaded individually on racks to prevent them from coming in contact with each other during fur-

nace heating and quenching. Then the rollers had to undergo a separate tempering operation. Rejections for improper heat-treatment ran high, whereas with induction hardening, rejections have been practically eliminated. With induction hardening as performed in the manner outlined, each bearing roller receives an identical treatment. The length and amount of heating, the duration of the water quenching, and other factors are the same for each roller. The present method is also decidedly more economical from the standpoint of power consumption and handling charges.

A set-up devised for hardening 37-tooth spur gears of 9 1/2 inches outside diameter right on the Tocco machine is shown in Fig. 6. These gears are 1 1/2 inches wide. In this case, the combination inductor and quenching chamber completely surround the gear periphery. An important point with this operation is that the gear teeth are shaved before the hardening operation; this can be done because the heat-treatment is conducted with practically no distortion. After the operation, the gear run-out is less than 0.0005 inch. As the gears are completely free from scale, no further finishing is necessary. The slight discoloration is removed by pickling the gears.

When the gear is placed in the inductor, it is spun by hand, and the electric current is then turned on, with the result that the gear teeth are heated to approximately 1550 degrees F. while revolving at from 15 to 20 R.P.M. At the end of the heating cycle, the girl depresses a plunger that extends through the inductor, as illustrated, to insert a pin between two of the gear teeth. In this manner, the gear teeth are located with respect to the quench holes in the inductor so that water is directed against the sides of all teeth. Heating requires fourteen seconds, and quenching one second. At the end of this operation, the S A E 4640 steel gear teeth have a hardness of between 40 and 45 Rockwell C. In operations of this sort, gears can be hardened completely from tip to root or along the sides only, as desired. Figs. 7 and 8, for example, show macrostructures of a hardened sprocket and gear, respectively, which give a clear indication of the depth to which these parts were hardened.

Fixtures of various types have been devised to facilitate the handling of parts of unusual design. One such fixture developed for hardening a long cam surface on a bracket forging of S A E 1045 steel is illustrated in Fig. 9. The cam surface extends the full length of the part along one side. Because of the changing contour, provision had to be made for automatically maintaining the same clearance between the

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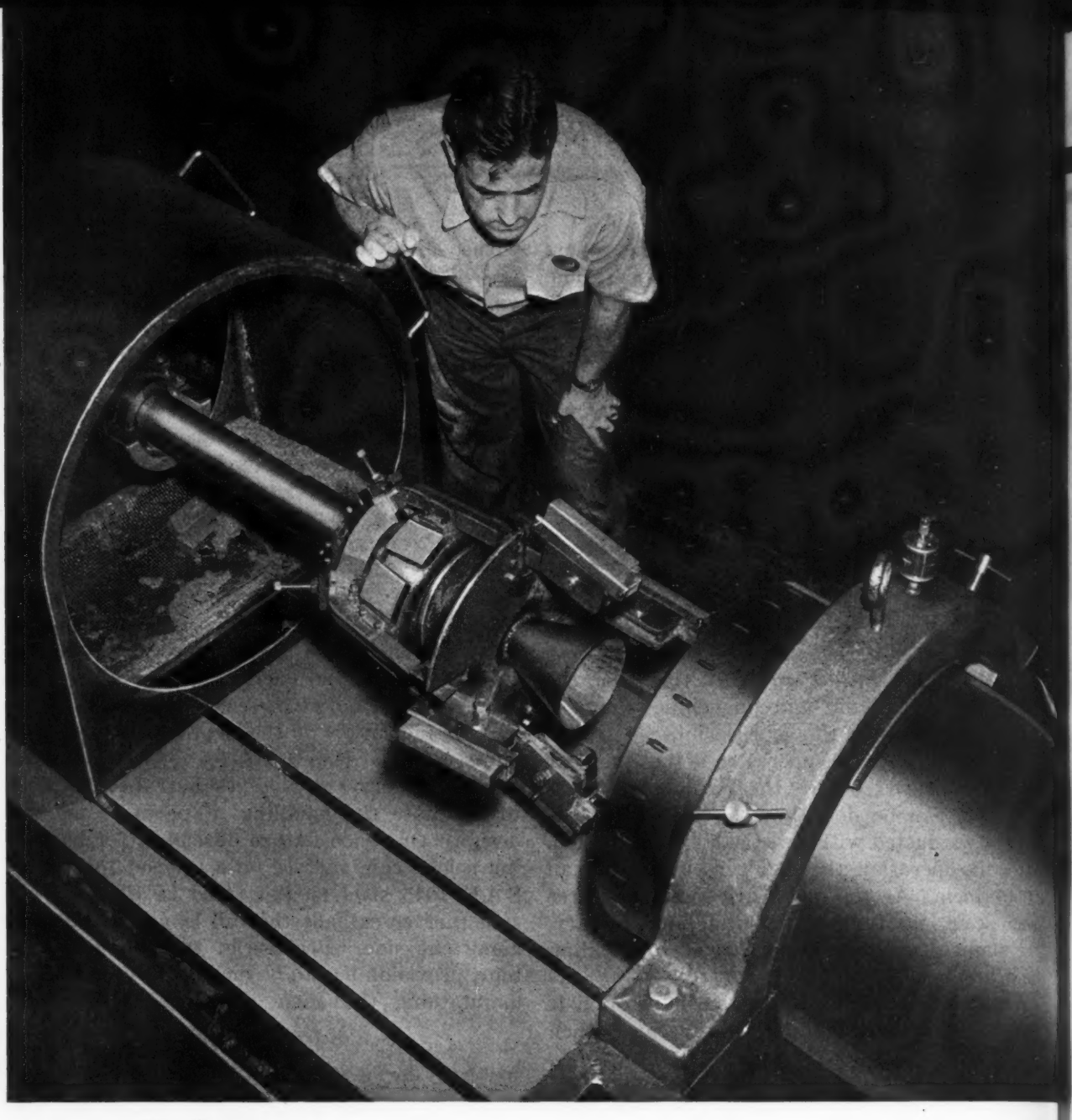
Fig. 9. Fixture for Hardening a Cam Surface of Changing Contour. It Maintains a Uniform Clearance between Inductor and Work



Rubber Tooling Aids Precision in Gun Plant

Rubber is Used for Guiding Cutting Tools and Expanding Holding Devices in a Naval Ordnance Plant where Guns of Highest Quality are Turned out on a Production Basis

By ALFRED WEILAND, Vice-President and General Manager
General Machinery Ordnance Corporation

GUNS of highest precision are being turned out on a real production basis at the plant of the General Machinery Ordnance Corporation, South Charleston, W. Va., through the application of unusually efficient tooling methods, many of which are original with this concern. Because of this tooling, guns ranging in size from 20 millimeters up to 6 inches are being produced to stringent Navy specifications by mainly unskilled workers. A large percentage of the employes come from farms in the mountains of West Virginia and many of them are women.

With this type of personnel, it was absolutely necessary that the accuracy of the guns depend upon machines and tooling instead of on the human element. In the past, gunmaking was considered an art that required years of experience, and, therefore, a job for skilled craftsmen only. By the methods employed at the General Machinery Ordnance plant, the guns are of a more uniform precision than those made in former years, because they do not vary with the capabilities of individual craftsmen. How successful are the practices followed is apparent from the fact that 100,000 guns of various sizes were produced within thirty-six months from the day that the first machine tool was started up in this plant.

The special tools employed include many examples in which rubber is used either for guiding purposes or for expanding abrasive stones radially for the honing of internal surfaces. Rubber, for instance, is used instead of the customary hard maple for the packed bit-tools employed in boring the guns. One of these packed bit-tools is seen in Fig. 1 being used in a lathe for boring a 5-inch 38-caliber gun. Four of them are illustrated on a bench in Fig. 2, the three at the left being roughing tools and the one at the right, a finishing tool.

Rubber is applied to these packed bit-tools in the form of four molded blocks, two being mounted on each side of a central steel frame to which two cutter bits are attached on one end and a shank on the opposite end. The rubber blocks are flat on the side that comes in contact with the frame and semicircular on the side that engages the gun bore. After being mounted on the frame, the rubber blocks are ground in a cylindrical grinding machine to a diameter 0.008 inch larger than the bore to be machined. Before using one of the roughing packed bit-tools, the muzzle end of the gun is bored with a single-point tool for a length of 8 inches to provide a bearing surface for the rubber packs when the cutter bits start machining. From then on, the rubber packs guide the tool from the surface that is being machined in the operation. In the case of the finishing packed bit-tools, the muzzle

Fig. 1. Rubber-packed Bit-tools are Used in Rough- and Finish-boring Guns Instead of the More Conventional Wood-packed Tools

Fig. 2. Four Rubber-packed Tools of the Type Used in Boring Guns, the Three at the Left being Provided with Roughing Cutter Bits and the One at the Right with Finishing Bits

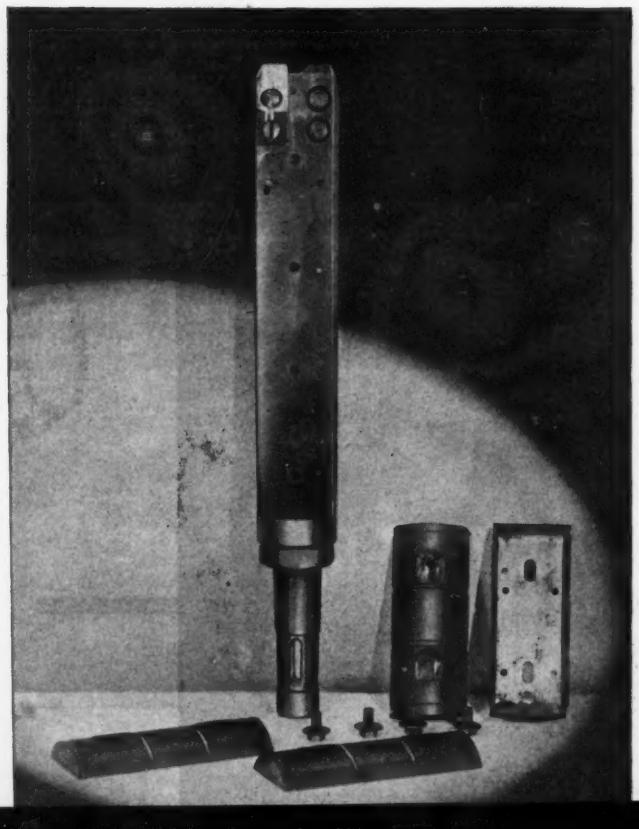
end of the gun is ground for a length of 8 inches to insure accurate guidance of the tool.

The diameter of the rubber section on packed tools for 3-inch guns is also 0.008 inch greater than the bore that the tool is designed to machine. On 20- and 40-millimeter guns, however, the difference between the rubber packing and the roughed or finished gun bore is 0.002 and 0.006 inch, respectively, and in the case of 6-inch guns, 0.010 inch.

The big advantage derived from the use of rubber packing on these boring tools is that this type of packing lasts much longer than the hard-wood blocks that are conventionally used for this purpose. The hard-wood packing becomes oil-soaked and expands to a greater diameter than desired, and, therefore, must generally be discarded after a single application of a boring-bar. Rubber, on the other hand, utilizes the oil for lubricating the sliding surfaces but repels it against soaking into the interior. Rubber packing ordinarily lasts for an average of five guns and it can then be shimmed to again bring the diameter up to size for regrinding. This practice can be repeated a number of times before the rubber need be discarded.

Another advantage obtained from the use of rubber packing in gun boring is that, whereas the hard-wood packing gives out annoying squeals as the tools are fed through the guns, due to the pressure between the hard wood and the gun bore, rubber packing is silent. The only noise is the sound of the cutter bits themselves as they are fed along the gun bore. On a 5-inch 38-caliber gun, the bore length is approximately 200 inches and close tolerances must be maintained the entire length.

Fig. 3. Disassembled Rubber-packed Bit-tool Showing Steel Frame Construction



The construction of these rubber-packed bit-tools is shown by the disassembled view in Fig. 3 and the assembly and detail drawings in Fig. 5, the latter showing the design of a packed bit-tool for a 3-inch gun. The rubber blocks are molded from Neoprene and have a durometer reading of 90. A steel insert, such as shown at *Z*, is molded into the flat side of the rubber blocks to provide a means of attaching the blocks to the steel frame of the boring tool.

Detail *X* shows the design of the cutter bits used on a roughing packed bit-tool. It will be seen that the cutting edge is inclined at an angle of 40 degrees from a line passing through the center of the tool. This gives a cutting point of substantial thickness. Cuts up to 1/2 inch deep

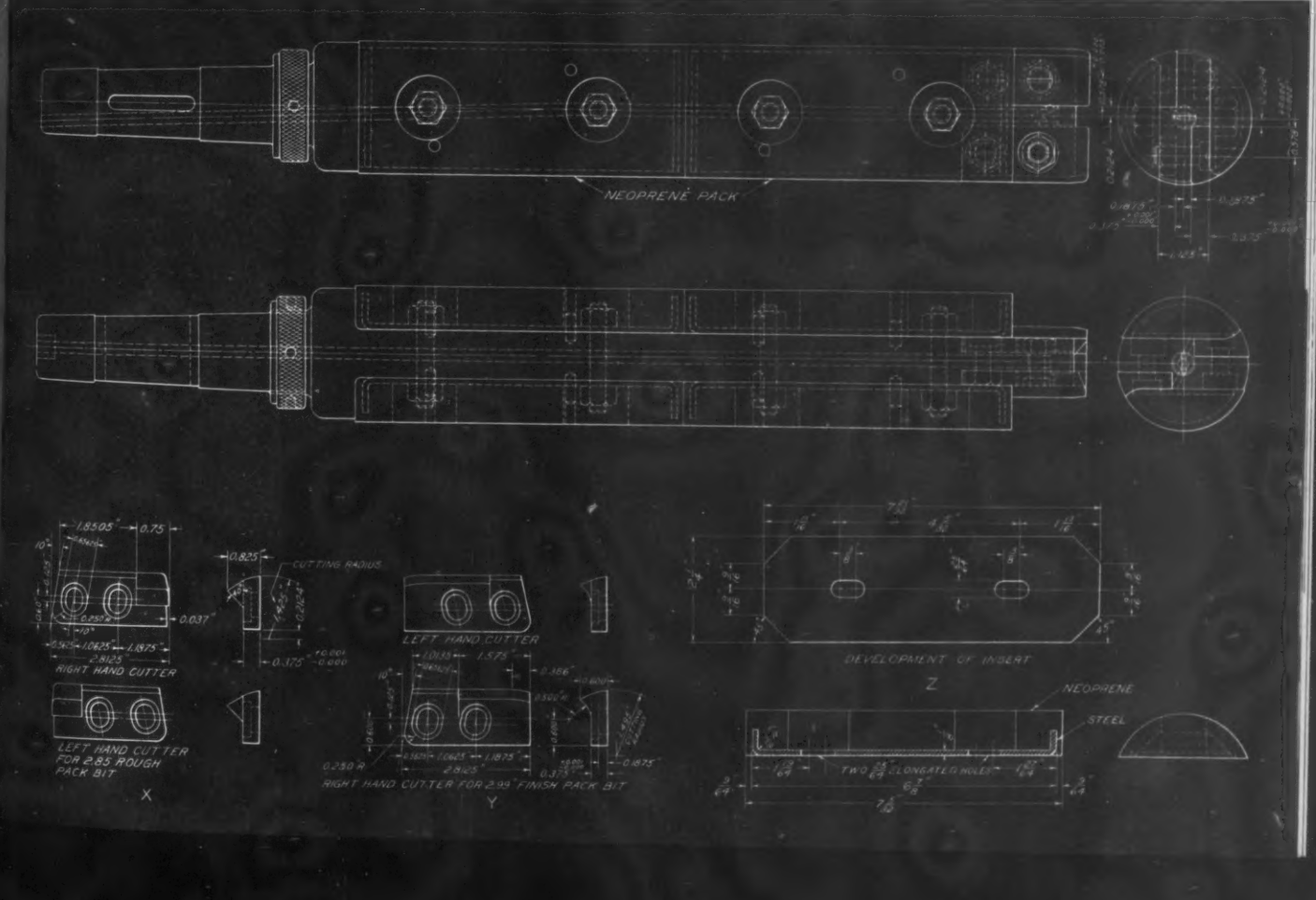
are taken in rough-boring. Detail *Y* shows the design of a cutter bit used on finishing tools. Cuts up to 0.070-inch deep are taken in finishing. A groove on the under side of the steel frame to which the rubber blocks are attached, carries cutting oil from a hole in the shank directly to the cutter bits.

No special problem is involved in grinding the rubber packing to the required diameter. A fairly rough grinding wheel should be employed and the work should be revolved at a speed not exceeding 75 or 80 R.P.M. If the work is run too fast, there is the tendency to grind the rubber blocks out-of-round. The feed of the table should be comparatively fast and should be about equal to the width of the grinding wheel for every three revolutions of the work. The cutter bits are mounted on the steel frame prior to grinding the rubber blocks, so as to insure that the rubber will be ground in relation to the cutting edges.

After the guns have been finish-bored by means of packed bit-tools, they are semi-finish turned in a lathe and the outside diameter is finished by subsequent grinding operations. In order to perform these operations with the work supported between centers, a plug, such as seen in Fig. 4, is inserted into each end of the gun

Fig. 4. Plugs with Radially Expanded Rubber Inserts Enable the Finish-turning of Large Gun Barrels on Lathe Centers

Fig. 5. Construction Drawing of Rubber-packed Bit-tool for Boring 3-inch Guns, and Detail Views of Cutter Bits and Rubber Inserts



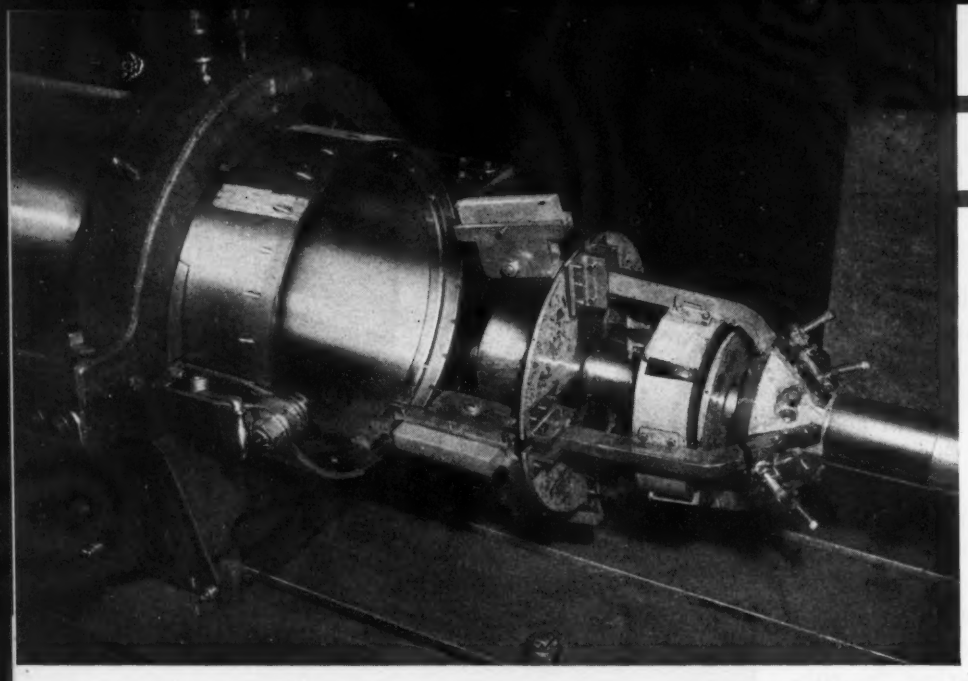


Fig. 6. (Left) Ingenious Honing Head which Employs a Rubber "Doughnut" for Radial Expansion of Abrasive Stones

Fig. 7. (Right) The "Doughnut" Used in the Honing Head Shown in Figs. 6 and 8 is Made of Solid Rubber, which Gives a More "Fluid" Action than if the Part were Hollow

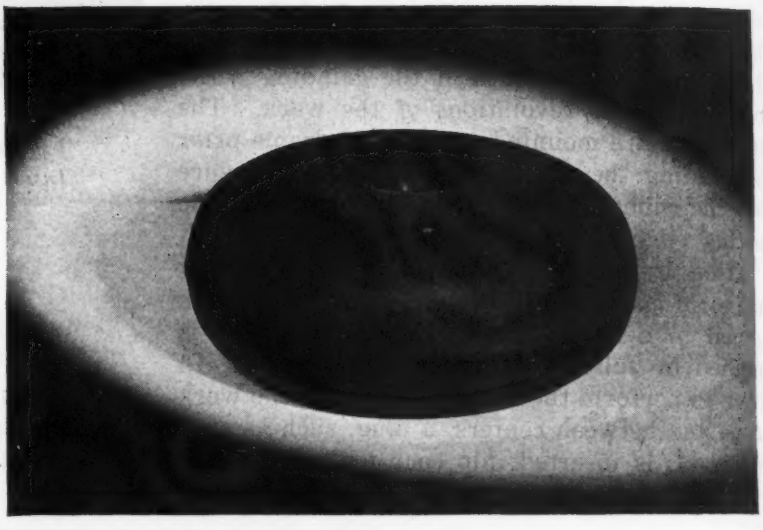


Fig. 8. (Below) Assembly Drawing of Abrasive Head Shown in Fig. 6, which Makes Use of a Molded Rubber "Doughnut" for Radial Expansion of Abrasive Stones after the Head has been Entered into a Torpedo Air Flask

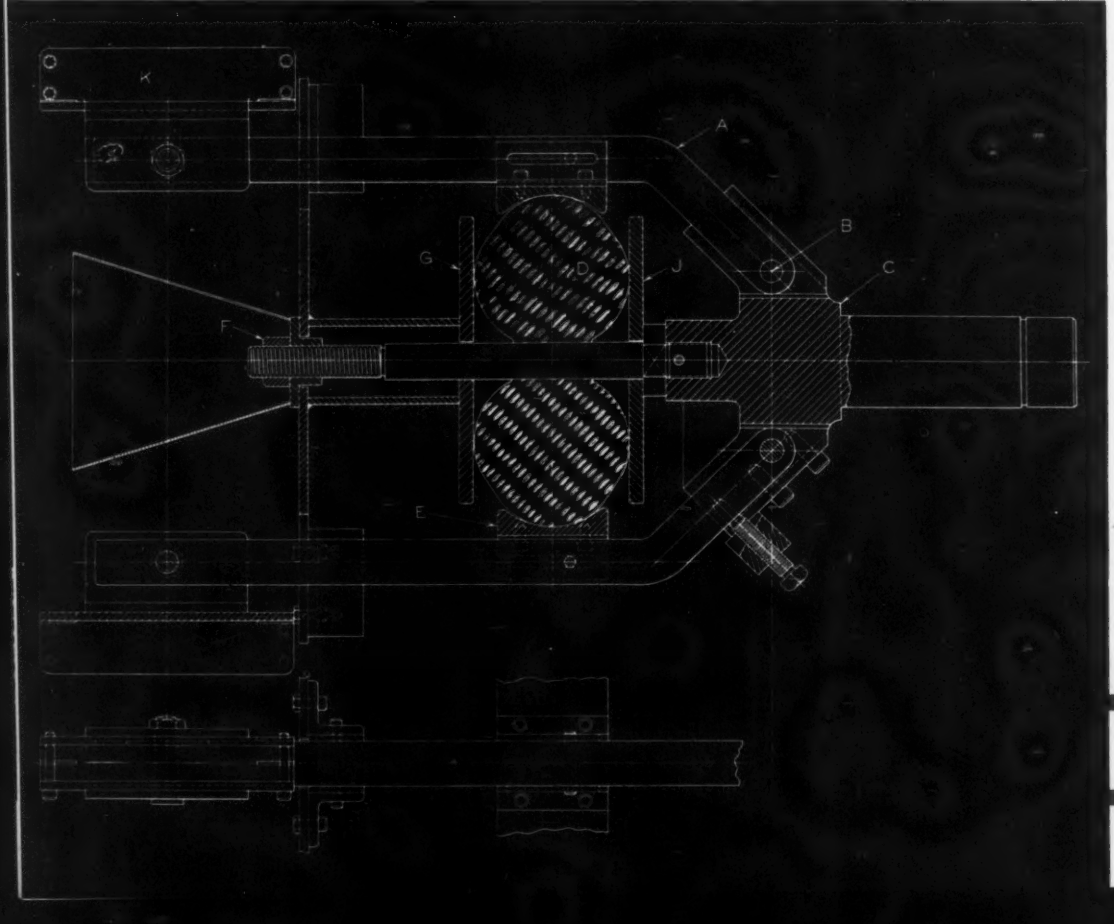


Fig. 9. In Honing the Rifle Grooves in Gun Barrels, a Head is Used in which Abrasive Stones are Backed up and Expanded Radially through the Use of a Rubber Plug

bore. This plug consists of a steel sleeve that is provided with six slots for rubber which are equally spaced around the periphery and positioned parallel with the axial center line. The slots for the rubber are approximately 4 3/4 inches long by 1 1/4 inches wide. The cavity and the slots in the sleeve are then molded full of rubber. After the plug has been entered freely into the gun bore, the molded rubber is expanded radially for tightly gripping the bore by turning a cap-screw in the center of the plug to advance a tapered member inside the rubber.

An ingenious head developed for honing torpedo air flasks, which have an internal diameter of over 19 inches that must be finished within a close tolerance for a length of almost 6 feet, is shown in the heading illustration and in Fig. 6. In designing a honing head for this operation, sufficient radial contraction of the abrasive stones had to be provided to permit the stones to clear a circular shoulder that extends around the inside of the torpedo air flask near the end. Otherwise, the honing head could not be entered into the work or removed at the end of an operation.

To meet this condition, the abrasive stones are mounted on the outer ends of four long spider arms *A*, Fig. 8, which are hinged at *B* to shank *C*. In the center of the head is a large doughnut-shaped solid rubber member *D* which is confined within four members *E* of a split housing. Pressure can be exerted on the sides of the rubber ring by tightening nut *F*, so as to push plate *G* toward plate *J*. When this is done, the rubber ring is expanded radially and arms *A*, with their abrasive stones in holders *K*, are forced radially outward to the honing diameter. The expansion is made after the honing head has been entered into the torpedo air flask past the interfering shoulder. The nut is adjusted from the opposite end of the torpedo flask by applying a wrench that is attached to the end of a long rod. On the

Fig. 10. Disassembled View of a Honing Head, such as Seen in Use in Fig. 9, for Finishing the Rifle Grooves in a 5-inch 38-caliber Gun

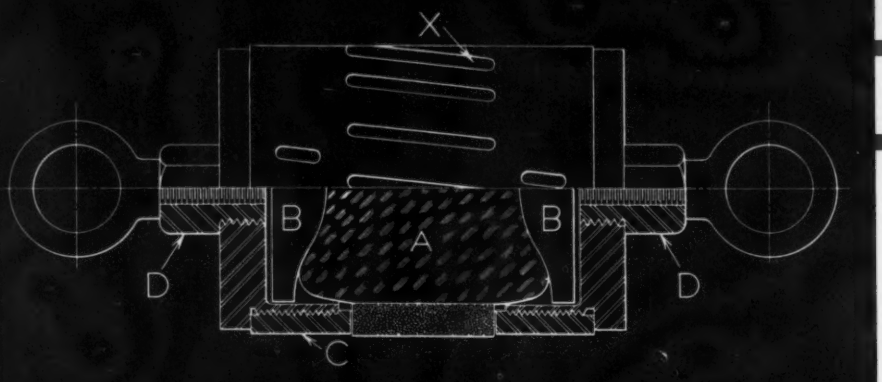


Fig. 11. A Construction Drawing of an Abrasive Head Employed for Honing the Rifle Grooves in a 5-inch 38-caliber Gun

honing head will be seen a funnel-shaped projection which assists in guiding the wrench to the nut.

When an operation has been completed, the abrasive stones are retracted by loosening nut *F* so as to reduce the pressure on the rubber "doughnut." This member has a durometer reading of from 50 to 60 and is also molded to size and shape. It is of the appearance shown in Fig. 7. Because of the rubber member being solid, a more "fluid" action is obtained than if it were hollow. Stock to a depth of about 0.030 inch is generally removed all around the inside of the flask for its entire length by means of this special head.

Rubber is employed in a variety of other honing and lapping heads to force the stones outward radially against the surfaces to be polished without the aid of mechanical arms or other devices. The abrasive stones are automatically released from the surfaces being polished when pressure on the rubber is reduced. A honing head of this type is seen at the left in Fig. 9 being entered into the muzzle of a 5-inch 38-caliber gun for honing the rifle grooves. This honing head is provided with fifteen abrasive stones which are entered into every third groove. The practice is to hone a set of fifteen grooves to the required finish for their full length, then withdraw the head, index it slightly, and enter the abrasive stones into another set of fifteen grooves. When this set of grooves has been finished, the head is withdrawn a second time and again indexed and entered into a third set of grooves. In this way all forty-five grooves are honed with one head.

At the right-hand side of Fig. 9 is seen another head that is somewhat similar in appearance to the honing head. This is a support which is fitted with inserts of Insurok that also enter the rifle grooves at a distance several feet behind the honing head. In combination with three Insurok inserts on the honing head itself, this support guards against too much pressure on the sides of the abrasive stones as they follow the helical rifle grooves. This provision has greatly reduced breakage of the abrasive stone.

The various details that make up such a honing head for a 5-inch gun are shown in Fig. 10. From the construction drawing in Fig. 11, it will be noted that a large rubber plug *A* (durometer 50 to 60) is confined within two steel plates *B* and a cylindrical housing *C*. When either of the two nuts *D* is tightened to advance the corresponding plate *B* against the rubber plug, the latter is expanded radially to push the abrasive stones outward. These stones are carried loosely in slots *X*. The construction of this honing head differs somewhat from that in Fig. 9, in that Insurok inserts are carried in slots ahead and behind those that contain the abrasive stones, instead of alongside of the ab-

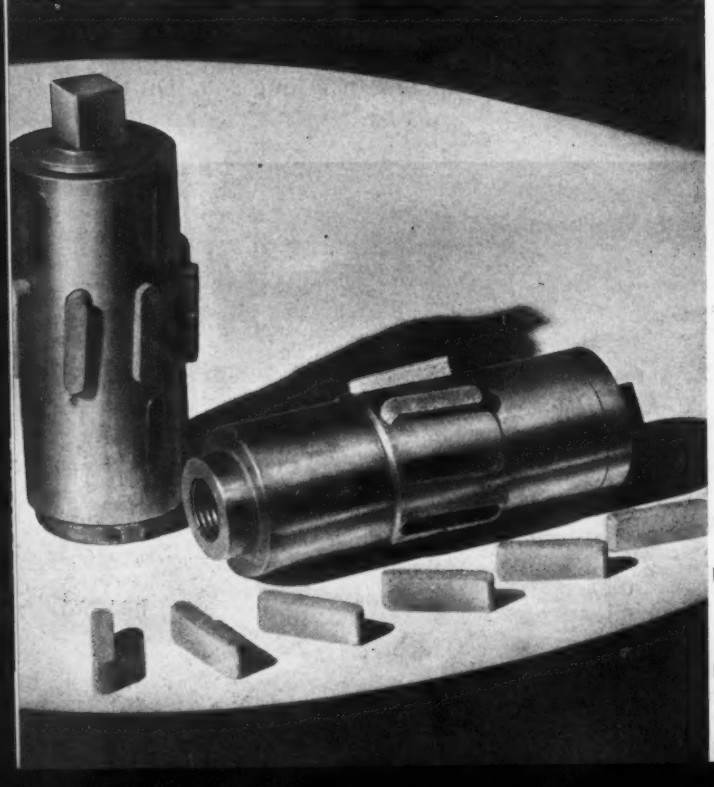


Fig. 12. Honing Heads Designed for Finishing the Rifle Grooves of 40-millimeter Guns

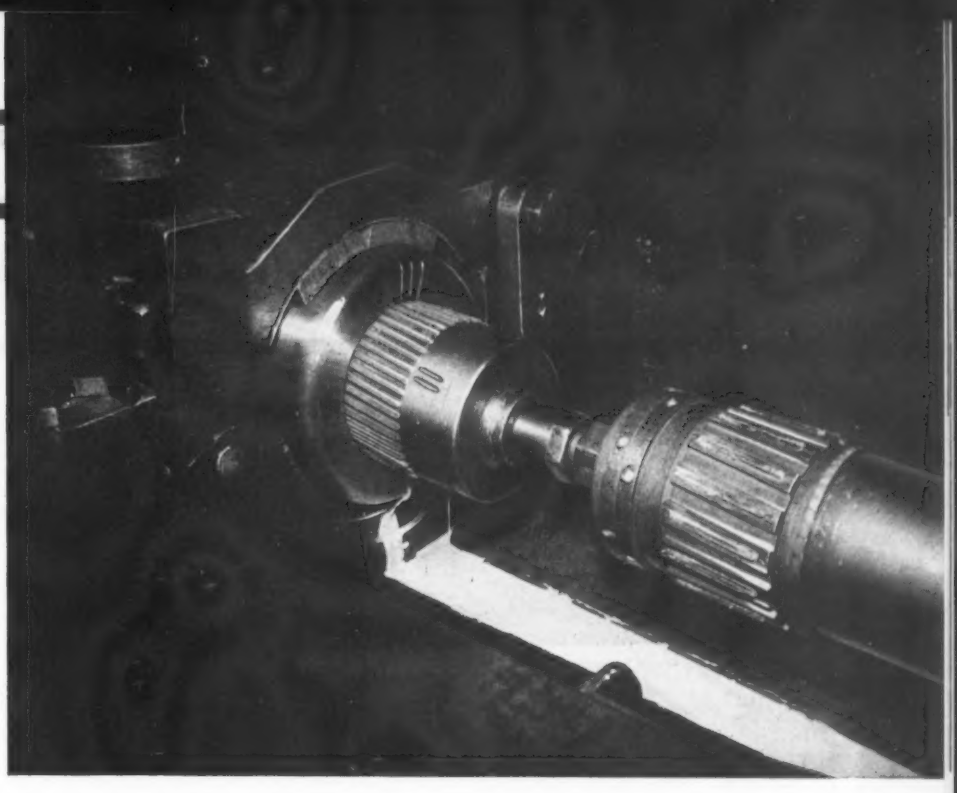


Fig. 13. (Right) Honing Heads for Smoothing the Rifle Lands of 5-inch 38-caliber Guns are Provided with Forty-five Abrasive Stones so that All Lands are Smoothed Simultaneously

Fig. 14. (Below) Details of a Head Used for Hand-lapping the Rifle Grooves of 40-millimeter Guns

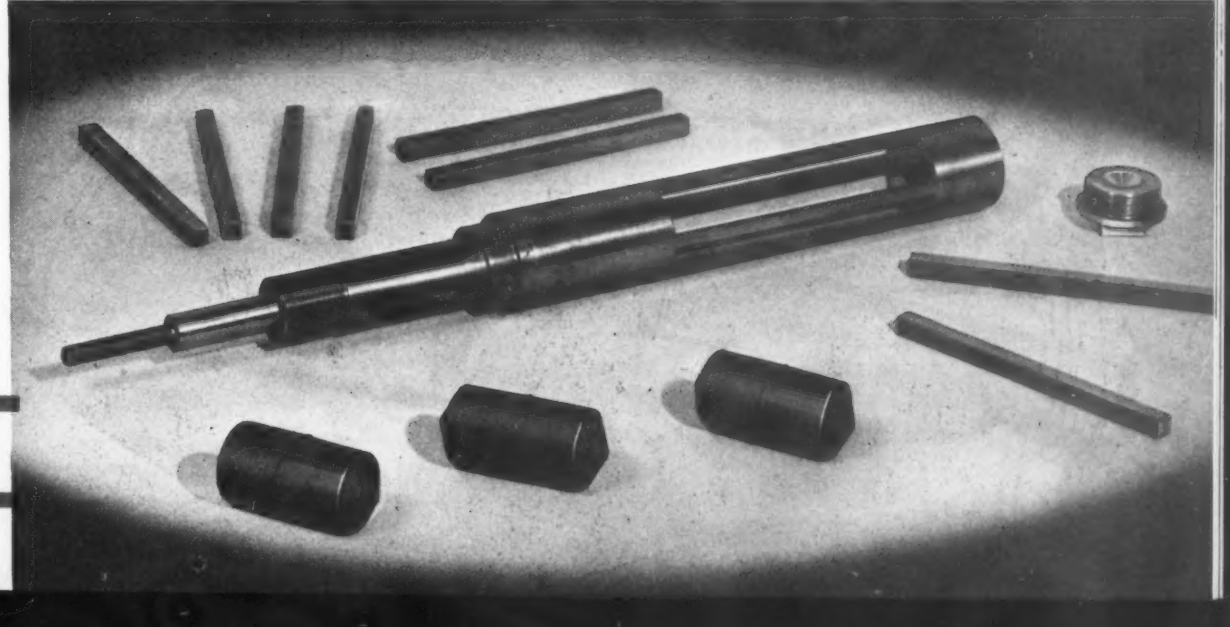
rasive stone slots. When these honing heads are withdrawn from a gun, a steel collar is slipped over the stones for retaining them in the body.

Somewhat similar honing heads, but considerably smaller in diameter since they are designed for use on 40-millimeter guns, are shown in Fig. 12. The principle of construction is the same as that of those already described.

The lands of the rifle grooves are also honed, a honing head for such an operation being illustrated in Fig. 13. In this case, there are forty-five abrasive stones, as all lands are honed at one time. This honing head, too, is guided by small Insurok inserts that ride in rifling grooves and a pilot is provided. In Fig. 14 are shown the details of a honing head used for hand honing the rifle lands of 40-millimeter guns.

Incidentally, the General Machinery Ordnance Corporation is believed to be the only naval gun manufacturing concern that hones the rifling grooves and lands. This practice removes any raspy edges that may exist on the lands and which would tend to shave the rotating ring on projectiles fired from the gun. Honing also insures that all finish lines will run in the same direction as the path of the discharged projectiles. All circular finish marks are eliminated by this practice. Furthermore, honing results in longer life of the tools that are used in broaching the rifle grooves, because when these tools wear slightly under size, compensating correction can be made in the honing. Finally, the closely honed bores insure a better gas seal when the gun is fired and, consequently, a more efficient discharge. A solution of soluble oil is used in the honing operations. The honing head is reciprocated in 12-inch strokes, while the carriage to which it is attached is fed gradually forward until the gun bore has been honed.

Rubber tools impregnated with abrasive for use in a variety of polishing operations will be described in a coming number of MACHINERY.



Drawing Tubelike Tanks

Official U. S. Navy Photo

from Aluminum Disks

Another Instance in which an Industrial Concern Achieved the Impossible in the Manufacture of Urgent Wartime Ordnance Materiel

By GORDON B. ASHMEAD

IN the middle 1930's, the Navy Ordnance Department devised new plans for handling the powder charge that gives impetus to the projectiles fired from large guns. These plans required that the charge be contained in a brass shell similar to the familiar 22-caliber blank cartridge but, of course, many times larger. Knowing that when these powder shells were used in battle they would be subjected to rough handling and, in addition, be exposed to moist sea air—possibly drenched by the sea itself—provisions were made for protecting the powder shells in a container or tank until seconds before their use. This was necessary in order to insure dry powder and to keep the shell free from corrosion or oxidation so that its entry into the gun breech would not be impeded.

A decision was reached to make this cartridge tank of aluminum. The design called for a long tube closed at one end and fitted with an air-tight lid at the opposite end. The designers preferred that the body and its bottom be made in one piece so as to reduce to a minimum the possibility of air or dampness entering the tank.

Manufacturers struggled for three years with the problem of producing tanks of this design but not one satisfactory tank was drawn to the required length in one piece. The difficulty was due to the fact that the inside diameter of the tank was only slightly more than 5 inches, while the length was over 30 inches. It became the concerted opinion of the industry that such a tube could not be produced. Consequently, deviations were granted to permit the bottom of the tank to be cupped and an aluminum tube welded to this bottom. The experimental phase in the production of these tanks ended in the late 1930's, when ominous clouds hung over Europe. Bids were invited for the production of the cartridge tanks and the low bidder was the Norris Stamping & Mfg. Co., Los Angeles, Calif.

Tooling was immediately started for the production of welded tanks, but Mr. Norris, the owner of the company, was not satisfied with the previous work that had been done on the project. Aluminum welding in those days was not the satisfactory process that it is now and porosity was too high in aluminum welds. So, while starting the tooling for welded cartridge tanks, Mr. Norris began a private research to determine upon means of producing the tanks to the original specifications, that is, with a one-piece bottom and body.

Samples produced by the methods evolved were submitted to the Navy Department and tested by Navy engineers in every conceivable manner. They were cut apart and examined for a hidden weld, because it was still believed that it was impossible to produce the tanks in one piece. Permission was eventually given for the manufacture of these one-piece tanks. In fact, the Norris concern never completed the tooling for production of the welded tanks.

The 5-inch 38-caliber aluminum cartridge tank manufactured by the methods to be here described has four main metal components—the body, top ring, insert, and cover ring. The insert, top ring, and cover ring are not difficult stampings to produce and their manufacture will, therefore, not be discussed. The tank body starts as a disk of 0.090-inch aluminum sheet, 20 5/8 inches in diameter.

This disk, after being well lubricated with a mixture of vegetable and mineral oils, is formed in four stages. The wall thickness after all four operations is approximately the same as the

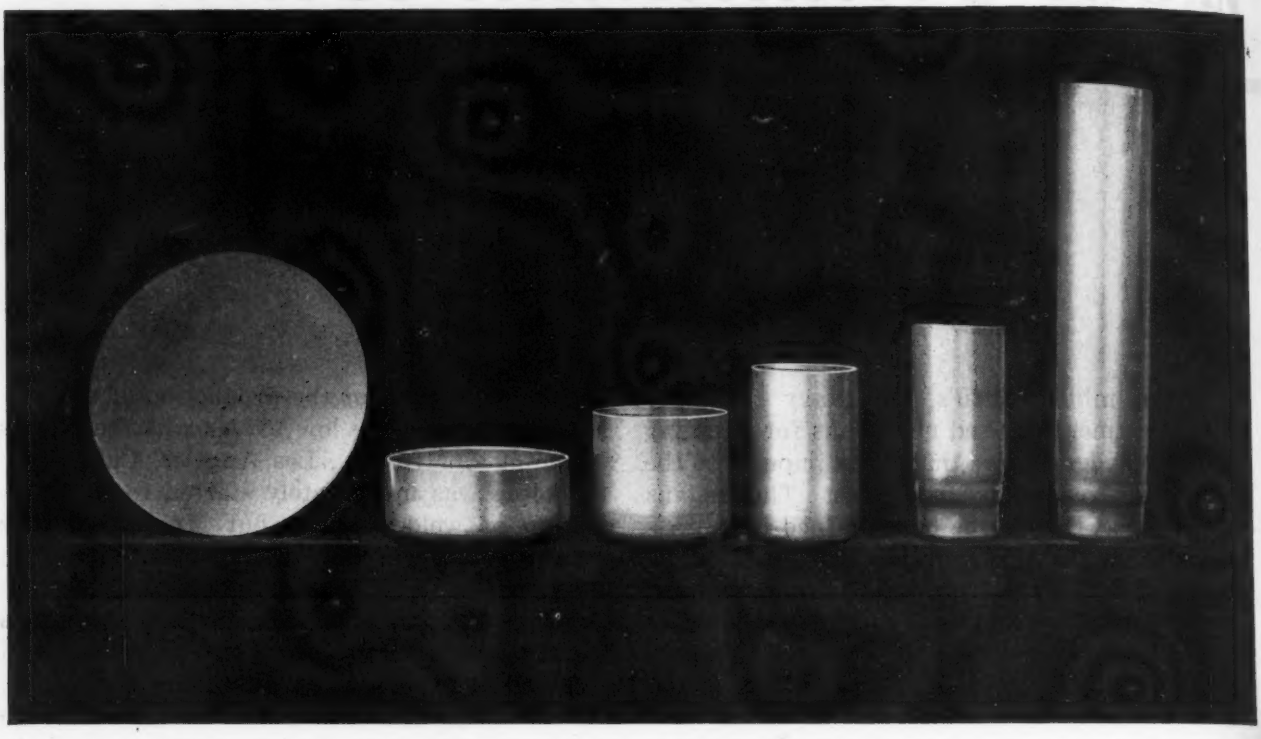


Fig. 1. Aluminum Disk 20 5/8 Inches in Diameter from which Tubelike Tanks with a Solid Bottom are Produced, and Examples of the Work after Four Forming Operations and a Series of Drawing Operations

thickness of the original disk, the surface area of the piece after each operation being almost the same in spite of the different shapes. After the last forming operation, the shell is of the appearance shown by the second example from the right in Fig. 1. The base at the end of the fourth forming operation is the finished base of the tank. It is still 0.090 inch thick so as to withstand the hard usage that will be encountered in service.

After the fourth forming operation, the part is ready for elongation to its full length, as shown at the extreme right in Fig. 1. This is accomplished by a series of drawing operations. At a point sufficiently distant from the closed end to receive a stacking ring, the thickness of the side wall is reduced and, in direct proportion to this reduction, the surface area of the wall is increased. After the proper length has been obtained, the stacking ring is bulged into the thick side wall of the body near the base of the tank. This ring is forced into the aluminum shell hydraulically by the application of quick opening dies.

A battery of standard punch presses which have been adapted to performing the following operations in sequence is illustrated in Fig. 2. The elongated tank is first trimmed to its finished length, not by a conventional one-piece trimming method, but by cutting segments of excess stock from the open end. The small pieces of scrap aluminum obtained in this operation are easily shoveled up and can be packed densely for shipment to reclaiming plants. When it is considered that a great number of cartridge tanks are trimmed daily, it will be understood that the problem of scrap removal could get out of hand quickly if other than these small flat scraps had to be handled.

From the trimming operation, the tank is transferred to the next press which reduces the open-end diameter to its inside tolerance. The succeeding operation expands a series of location beads for the top ring in the open end.

This top ring, which is an aluminum stamping, is next slipped over the top of the tank and down to the locating bead. Thus assembled, the two pieces are placed in the last punch press for permanent joining together by means of a heavy locking bead that is expanded into both parts. A spinning operation is next performed by applying a drilling machine that is equipped with a rotating head containing three rollers. In this operation, the tank is inserted in a vertical chuck with the top of the body extending a fraction of an inch above the top ring. This projecting rim is spun around an interior shoulder of the top ring to form a tight joint.

The first inspection of the assembled tank body is made at this point. By the time the tank body reaches this stage, it is covered with mixtures of animal, mineral, and vegetable oils accumulated in the preceding operations and it must be thoroughly cleansed. Fig. 3 shows a compact cleaning and etching installation, by means of which the entire tank production can be handled by two workers.

Tanks roll from the inspection station down a gravity conveyor to this cleaning installation and are placed on the overhead conveyor as it descends from the upper section of the installation. As the cartridge tanks are carried into the equipment, they first receive an alkaline bath. They are then rinsed in hot fresh water, after which they are given a caustic etch, and this is followed by a neutralizing bath. After a second rinse, the tanks are subjected to a hot forced-air draft in the drying compartment, and

Fig. 2. Battery of Punch Presses and a Drilling Machine which are Employed for the Performance of a Number of Detail Operations on the Aluminum Cartridge Tanks

Fig. 3. Equipment Employed for Thoroughly Cleansing the Aluminum Cartridge Tanks of All Oils Accumulated on Their Surfaces during the Various Manufacturing Operations

as they emerge at the top of the structure they are removed before they again reach the loading position.

The clean cartridge tanks are too hot for subsequent operations as they come from the drying compartment. They are, therefore, placed on a moving conveyor and drawn under a blast of cool air which reduces them to room temperature.

Rubber cement is next applied on the shoulder of the assembled top ring, where the body has a rolled joint, and a rubber gasket is placed over the cemented area. This gasket makes an air-tight seal between the tank body and the cover ring or lid of the finished cartridge tank, but to insure that the gasket is leakproof the finished tank is transferred to a testing machine, where a measured amount of air is delivered into the tank and held for a predetermined period. Automatic alarms (a roller which makes a mark in black ink on the defective tank and a blinking light) expose any loss of air, even an amount that could escape from a hole only 0.003 inch in diameter.

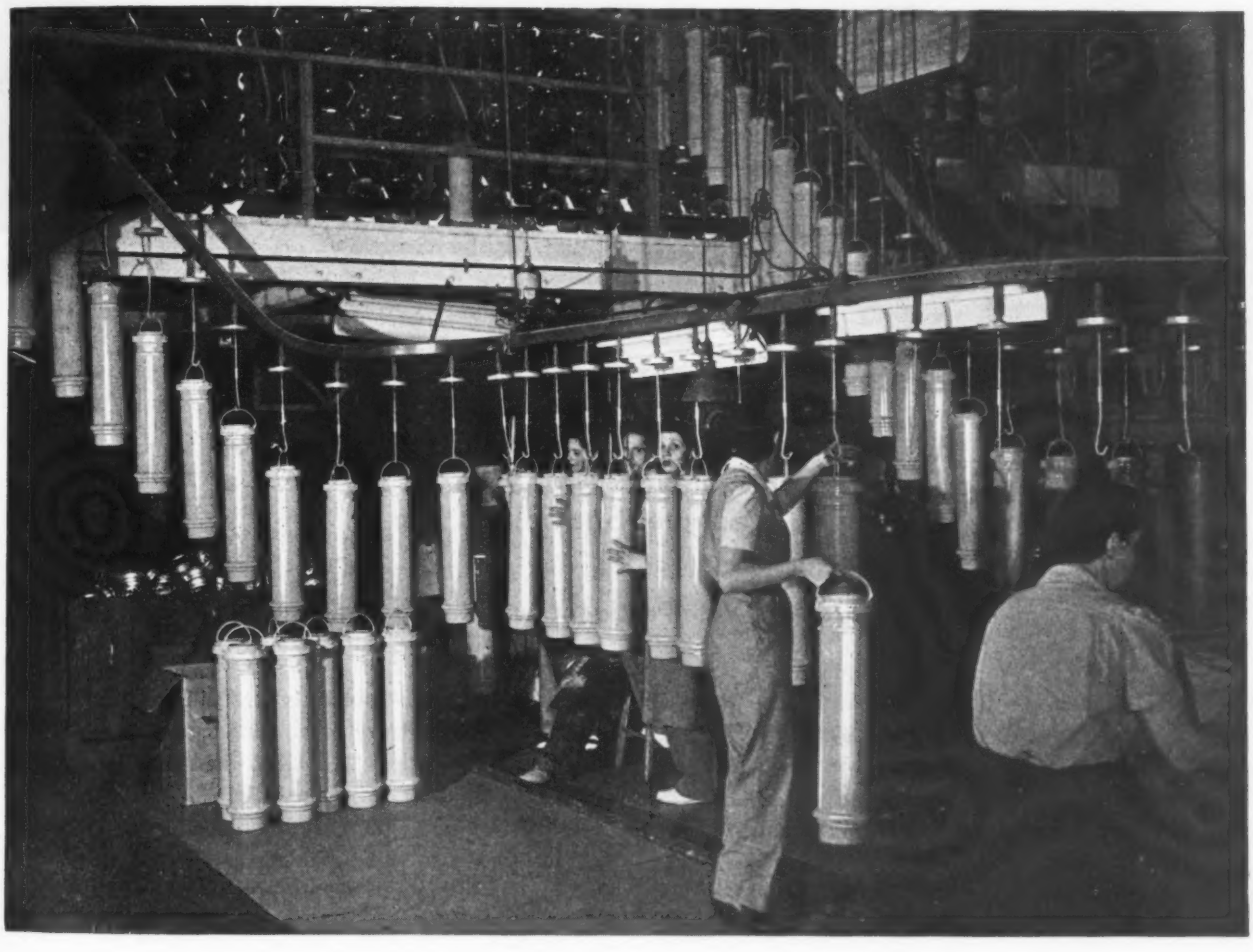
The cover ring is an assembly of two circular stampings provided with a handle. These two stampings are spun together and then given an air test similar to the one passed by accepted tanks. The cartridge tank and its cover ring are next assembled and checked for ease and

security of assembly, after which the completed unit is ready for its finish.

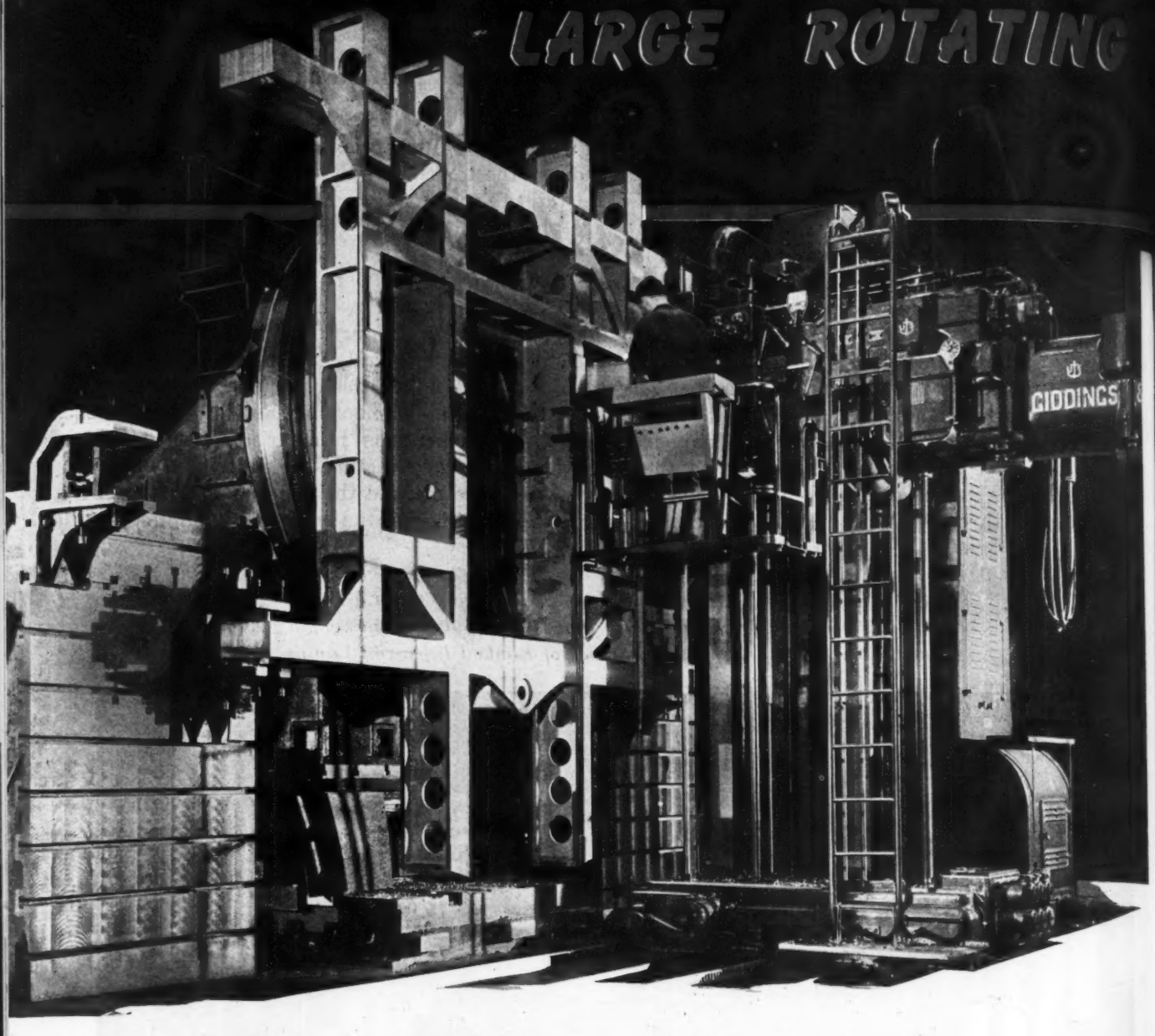
The finishing of the cartridge tanks requires the use of a conveyor over 500 feet in length, one end of which is seen in Fig. 4. The tanks loaded on this conveyor are slowly revolved through an electrostatic spray booth, in which they are sprayed with a synthetic gray baking enamel. After painting, the tanks are carried overhead and through a baking chamber of banked infra-red lamps which give off drying temperatures up to 265 degrees F. The enameled tanks would be too hot for handling as they come from the drying area and so the conveyor carries them through a heat-reduction chamber, in which a two-blower down draft system quickly reduces the tank surfaces to room temperature. As the tanks reach the unloading station, they are given a final visual inspection and are then ready for shipment.

When war broke out between the United States and the Axis Powers, the Norris concern stepped into high production of these tanks. As the stocks of aluminum began to vanish, the concern had to produce the cartridge tanks from steel to the same dimensions as the aluminum tanks. A tremendous number of steel tanks were manufactured before the aluminum shortage was overcome and the concern could return again to making the tanks from aluminum.

Fig. 4. Painting and Baking of the Enamel on the Cartridge Tanks Takes Place on a Conveyor that is over 500 Feet in Length and which Passes through a Chamber of Banked Infra-red Lamps



LARGE ROTATING



How the Application of Unorthodox Machine Shop Methods Expedited Naval Ordnance Production at Danly Machine Specialties, Inc.

By G. I. DANLY, Vice-President and Chief Engineer

THE fewer the number of machine set-ups required, the easier it generally is to finish accurate work within specified tolerances, because the various surfaces can be machined readily in precise relationship with each other. Acting upon this premise when planning machining operations for finishing the large structural weldments used as bases for single and twin 5-inch naval gun mounts, Danly Machine Specialties, Inc., Chicago, Ill., evolved an unorthodox practice that has proved highly efficient. Instead of forty-five to fifty different machine set-ups that would normally be required for machining these bases, the practice which the Danly concern developed necessitates only four machine set-ups.

WORK ON HORIZONTAL BORING MACHINES

Horizontal boring, drilling, and milling machines are used in this shop not only for customary operations performed by this type of machine tool, but also for the turning, boring, and facing of surfaces large in diameter. This means that the huge weldments must be rotated to permit the taking of a number of cuts which would ordinarily be performed on vertical boring mills. In other shops engaged in the production of these gun-mount bases, large planers, drilling machines, slotters, and both horizontal and vertical boring mills are employed.

Another important advantage of the Danly practice is that by using a horizontal boring mill for machining large diameter work, the operator is always close to the cutting tool, regardless of whether he is turning, boring, or milling around the outside or near the center of the work. In the case of the twin-mount gun bases, the maximum swing is approximately 18 1/2 feet, so that if the work is handled on a vertical boring mill and a cut is being taken near the center of a base, the operator is more than 9 feet away from the tool.

The closeness of operator to cutters that is obtainable with a horizontal boring machine was especially advantageous when the machining methods for the gun-mount bases were originally devised, because at that time a cap seat for the training pinion bracket projected 4 inches above a circular surface several inches in width. This circular surface extends completely around the weldment at a large diameter except where it is interrupted by the cap seat. This surface must be face-milled, and it was necessary to back the tool away from the work when the cutter reached the cap seat and then feed the tool in again after the seat had cleared the cutter. With the operator being able to stand close to the milling cutter, this unusual interrupted cut could be taken without difficulty and close accuracy maintained. In the present base design there is still an interrupted cut but as the cap seat no longer projects above the surface to be milled, it is no longer necessary to shift the tool. The milling cutter is merely fed across an air gap.

In order to adapt the horizontal boring, drilling, and milling machines for gun-mount base operations, it was necessary to provide them with means for power-revolving the work on a vertical table and for indexing the work in both horizontal and vertical planes. Four Giddings & Lewis boring, drilling, and milling machines were installed in the Danly shop for these gun-base operations. Two of these machines are equipped with a work-rotating unit, as seen on the machine in Fig. 1, required in turning, boring, or milling around surfaces of large diameter.

The other two machines were equipped with an indexing head such as illustrated in Fig. 2, which is mounted on a 7-foot square horizontal power-driven revolving table. By means of this arrangement, any surface on the work can be placed at single or compound angles in relation to the cutting tool. Two of the horizontal boring machines are of the Giddings & Lewis 30 Series with a 6-inch spindle and a 15-H.P. drive; one is of the 50 Series with a 7-inch spindle having a separate 15-H.P. motor, and other motors totaling 20 H.P. for the table and other drives; and one is of the 70 Series with a 7-inch spindle and a 40-H.P. drive.

The 30 Series boring, drilling, and milling machines are both equipped with the vertical power-driven revolving table, and the other two machines with the square horizontal power-driven revolving table and vertical indexing table. So far as the gun-mount bases are concerned, machines of the 30 Series have sufficient capacity. However, the 50 and 70 Series machines were bought because they were available without delay. All four machines were supplied with columns high enough to provide 10 feet of vertical travel for the headstock.

The vertical power-driven revolving tables are mounted on a special head of Giddings & Lewis design which slides on three ways to and

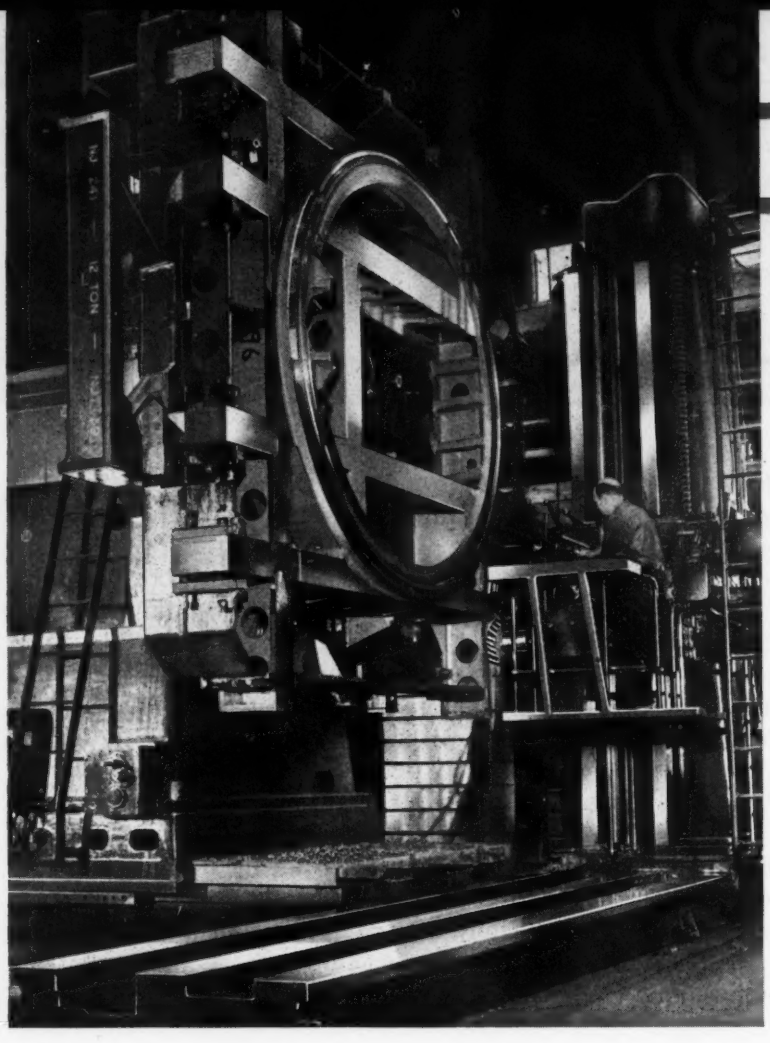


Fig. 1. Boring, Drilling, and Milling Machine Equipped with a Power-driven Rotary Table that Enables the Turning, Milling, and Boring of Large-diameter Surfaces on Naval Gun-mount Bases

from the machine column. The distance from the top of the ways to the center of the table is 126 inches. The length of work-head travel on the ways is 72 inches. The table diameter is 116 inches. The speed of table rotation on the periphery can be varied from 0.19 inch to 10 inches per minute on a 100 inch diameter through the hydraulic drive. Power for table rotation is conveyed from the hydraulic mechanism to the table through a vertical shaft and worm gearing.

Work fixtures are provided to suit either the revolving-table or indexing-table machines. These fixtures are removed from the machines to permit the weldments to be conveniently lowered into them and correctly positioned while suspended from a crane. The fixture illustrated in Fig. 4 is intended for use on the indexing tables, in which case the top of the base is placed uppermost in the fixture. A similar fixture is employed to hold the base with the under side up, thus enabling tools to take cuts around the various circular surfaces when the work and fixture are mounted on a machine having a power-driven revolving table.

The loaded fixtures are readily carried by cranes to the boring machines and accurately located on the

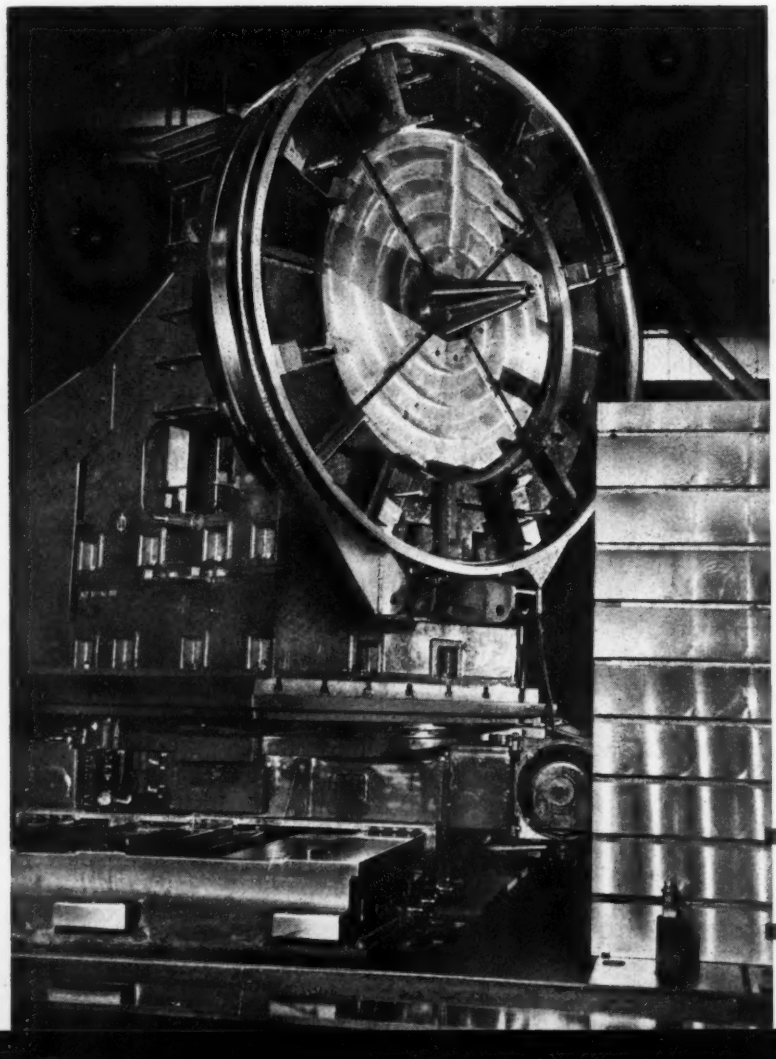


Fig. 2. Vertical Indexing Table Mounted on a Square Rotary Horizontal Table which Enables the Positioning of the Large Gun-mount Bases to Any Required Plain or Compound Angle with Respect to the Cutting Tools

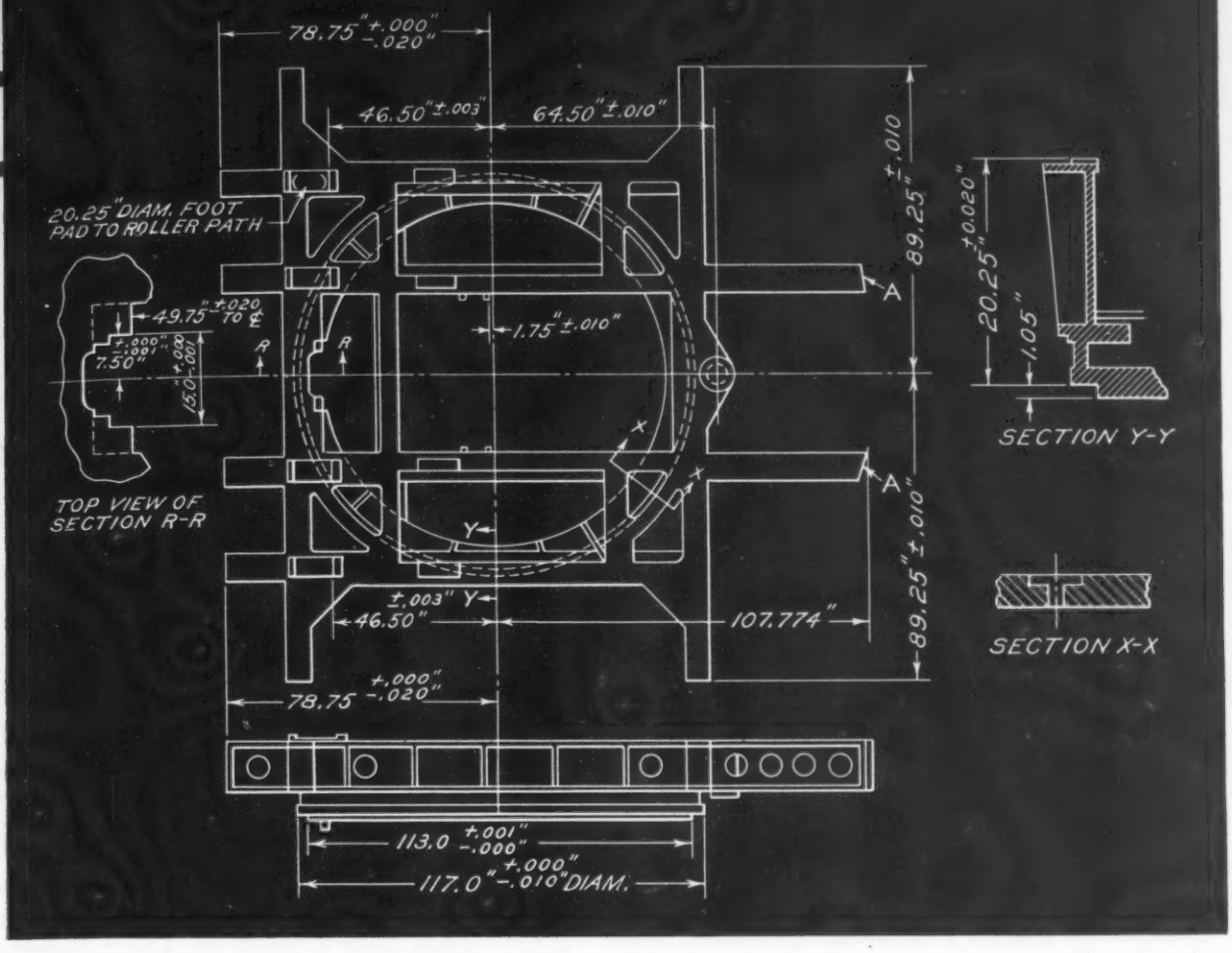


Fig. 3. Diagrammatic Drawing of the Base for a Twin 5-inch Gun Mount, which Gives Typical Dimensions that Indicate the Size of the Weldment and the Tolerances to which Important Dimensions Must be Held

vertical indexing or revolving tables by entering four radial keys that are attached to the back of the fixture into corresponding keyways on the front of the tables.

The first operation on the gun-mount bases is performed on a boring machine equipped with one of the vertical power-driven rotating tables. Various rough-milling cuts are taken on the large circular surfaces, on flat surfaces, on the ends of the two outriggers *A*, Fig. 3, which are at a radius of over 110 inches from the center of the weldment, and so on. A close-up view of one of the cuts performed in this first set-up is illustrated in Fig. 5. It consists of face-milling wide flat surfaces along the outriggers and the main structural members of the weldment by employing a cutter 12 inches in diameter. The work-table, of course, remains stationary for cuts of this type, the tool-head being raised and the machine column shifted to bring the cutter into line with the large number of similar surfaces to be milled in this manner. This will be apparent by referring to Fig. 1, which shows a similar operation on a face near the lower right-hand side of the weldment. The weldment is, of course, also indexed to lower the surfaces which are seen near the top of the machine in Figs. 1 and 5, to enable convenient milling.

Upon removal from this boring machine, the weldment is reloaded into a fixture suitable for mounting on the 70 Series boring mill, which is the one shown in the heading illustration. It will be noted from this illustration that vertical faceplates with T-slots running horizontally are provided on each side of the machine. Outriggers on the weldment are bolted to these faceplates to provide support in addition to that furnished by the vertical indexing table. This boring mill rough face-mills all of the flat surfaces on the top side of the weldment. Then the ends of all the outriggers, with the exception of outriggers *A*, Fig. 3, are rough-milled. Next, a hole 4 inches in diameter is bored to a depth of 6 3/4 inches to receive the centering post, and

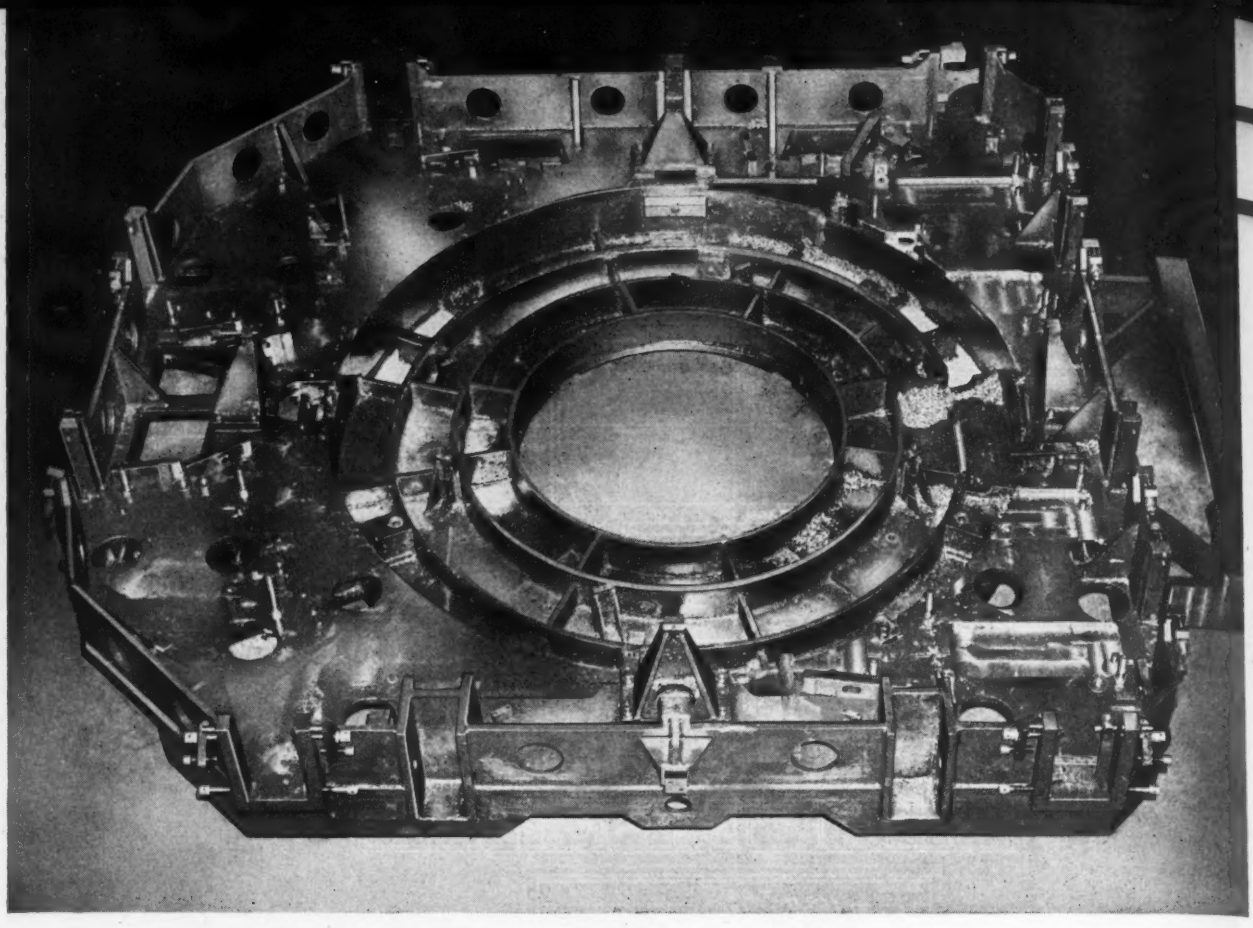
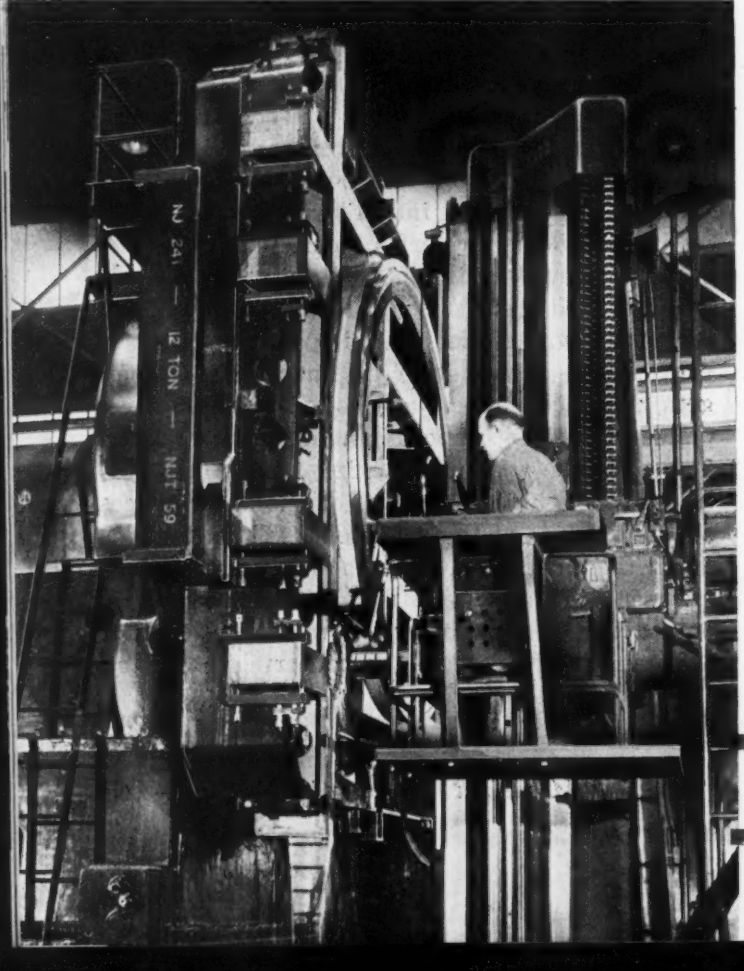


Fig. 4. (Above) Fixture in which Gun-mount Bases are Loaded Individually for Boring Mills Equipped with Vertical Indexing Tables

Fig. 5. (Below) One of Sixteen Cuts Taken in First Operation on Gun-mount Base, Consisting of Face-milling the Top of an Outrigger



then this hole is counterbored to a diameter of 7 3/4 inches and a depth of 1 1/2 inches, a special tool being utilized for these cuts.

The ends of the outriggers are rough-milled by employing a helical milling cutter 6 inches in diameter by 16 inches in length, which is held in a special bracket that is attached to the boring mill headstock, as shown in Fig. 6. Between cuts, the work fixture is indexed to bring the ends of the different outriggers successively to this tool. The same type of milling cutter is employed in the fourth and final boring mill set-up for finishing the ends of these outriggers.

When taken from this boring machine, the weldment is again placed in a fixture suitable for mounting on a power-driven rotating vertical table and for holding the bottom of the work toward the tools. Semi-finish and finish cuts are taken on the various surfaces that were rough machined in the first operation. In Fig. 7 is shown the method employed for finishing the ends of outriggers *A*, Fig. 3, at a distance of 110.275 inches, within plus or minus 0.010 inch, from the center of the weldment. These outrigger ends also must be machined at specified angles in relation to center lines of the weldment. However, these angles are easily attained because of the indexing table. It will be seen

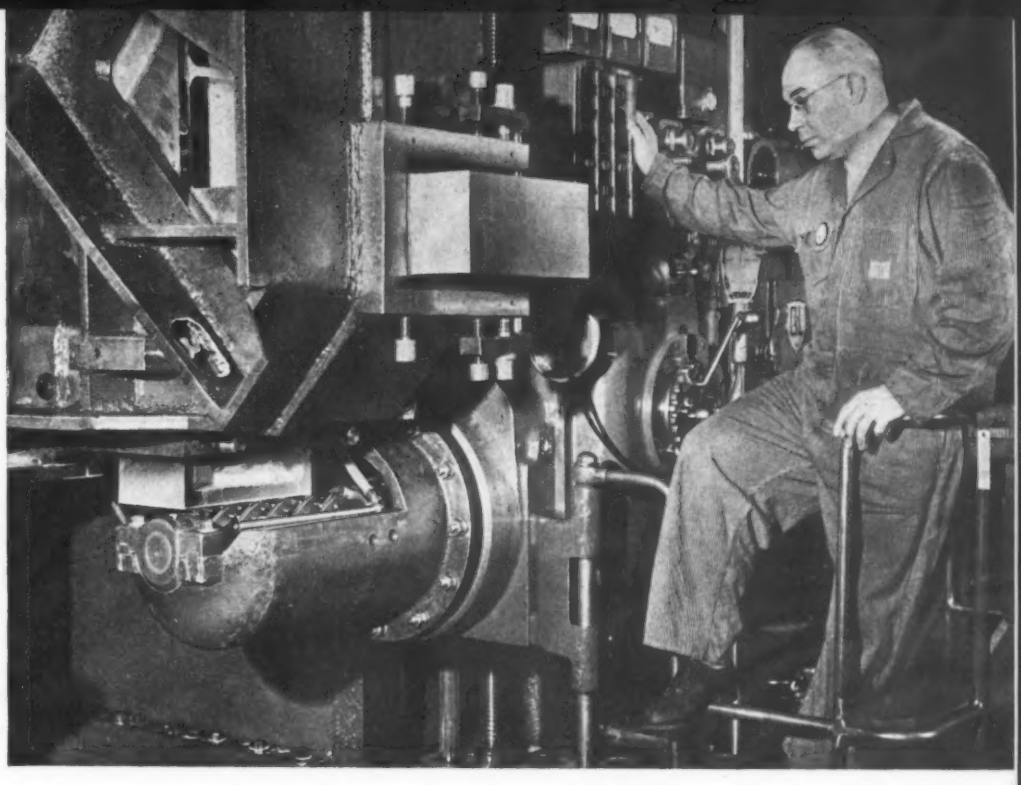


Fig. 6. (Right) A Helical Milling Cutter 6 Inches in Diameter by 16 Inches Long is Used for Rough- and Finish-milling the Ends of Eight Square Outriggers

Fig. 7. (Below) A Face-milling Cutter Mounted at the Outer End of a Long Right-angle Arm is Used in Milling the Ends of Two Outriggers at an Angle

that the outriggers are machined by employing a face-milling cutter on the outer end of a right-angle arm attached to the machine headstock.

Another unusual tool employed in this set-up is shown in Fig. 9. It consists of a circular milling cutter mounted in a cylindrical bar that is inserted through a bearing in a special fixture mounted temporarily on the work. This fixture serves as a means of accurately piloting the milling cutter during the machining of a keyway. Power for revolving the milling cutter, but not the cylindrical bar in which it is mounted, is supplied by the headstock spindle. The headstock spindle is fed forward to advance the cutter through the work and mill the keyway for a length of about 9 1/2 inches. On top of the cylindrical bar, immediately in back of the cutter, is a long keyway for guiding the cutter accurately in this operation. This special tool was produced by the National Automatic Tool Co.

In the same boring mill set-up, one of the large circular surfaces, after having been rough-milled and semi finish-milled in this and the first set-up, is finish-turned to a diameter of 113.004 inches within plus 0.001 inch minus nothing. The diameter given is for the large twin-mount base, but the same tolerance must be maintained on the single-mount base, in which case the ring diameter is nominally 86 inches. This turning operation is seen in progress in Fig. 10. A tool carriage of special design is mounted on the headstock of the boring mill for taking the accurate turning cut.

For the fourth boring mill operation, the weldment is placed in a fixture for mounting on the 50 Series machine, which is equipped with a horizontal rotary table and vertical indexing table. The weldment is located in the fixture from the circular surface turned in the third machine set-up. The fourth boring mill finishes the ends of the outriggers and takes a considerable number of other roughing, semi-finishing and finish-milling cuts.

One of the operations in this machine set-up

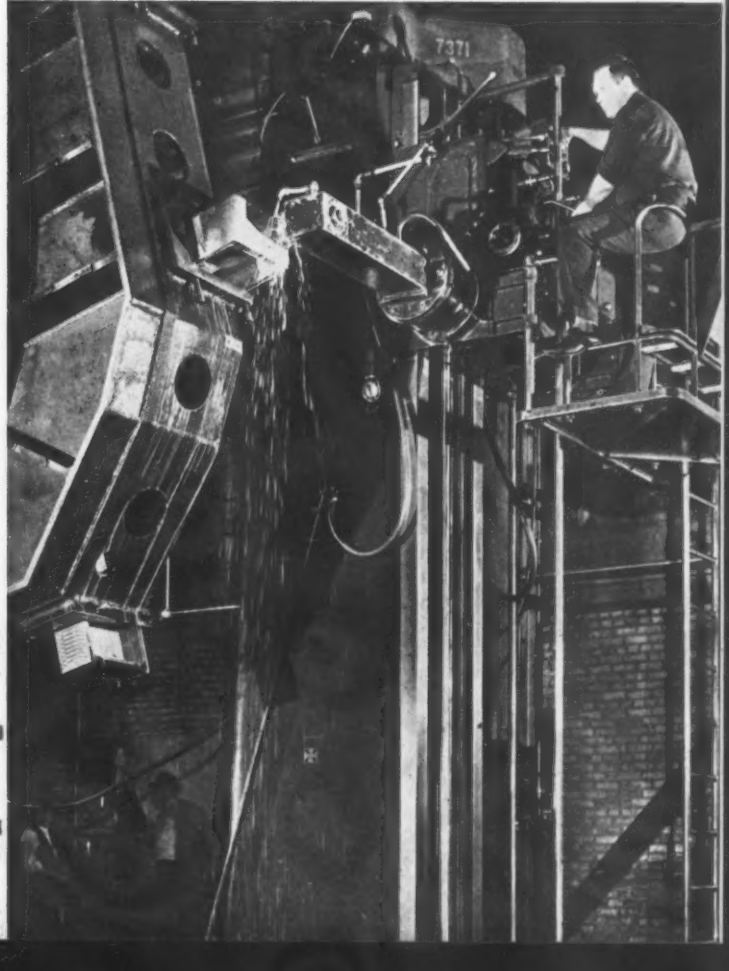


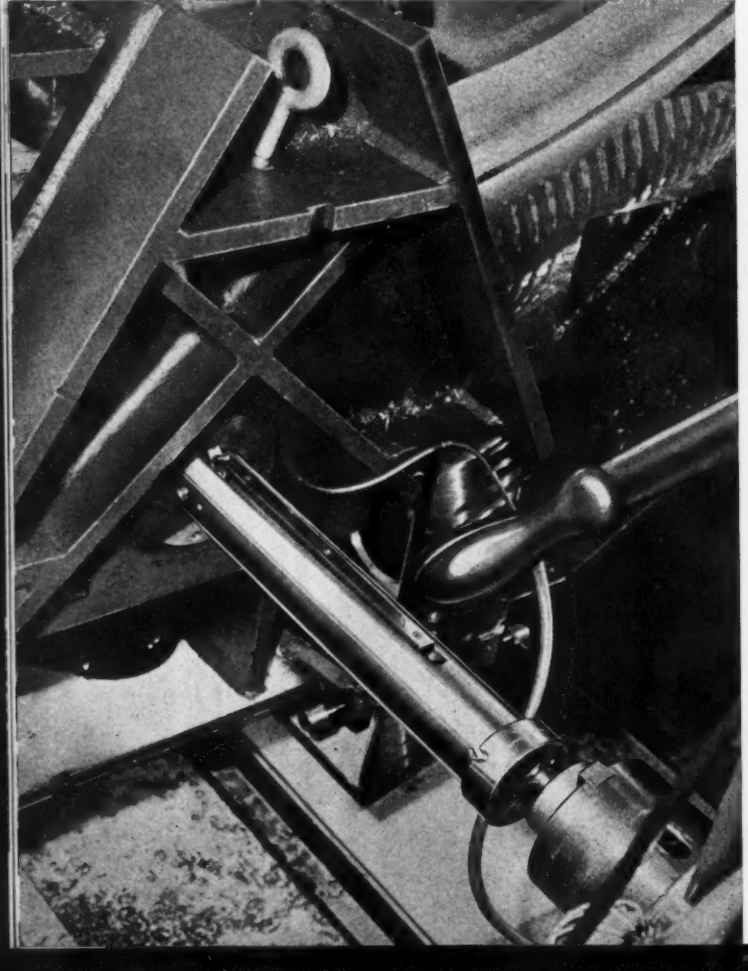
Fig. 8. (Left) Employing a Right-angle Attachment and End-mill for Machining a Series of Flat Surfaces on Brackets

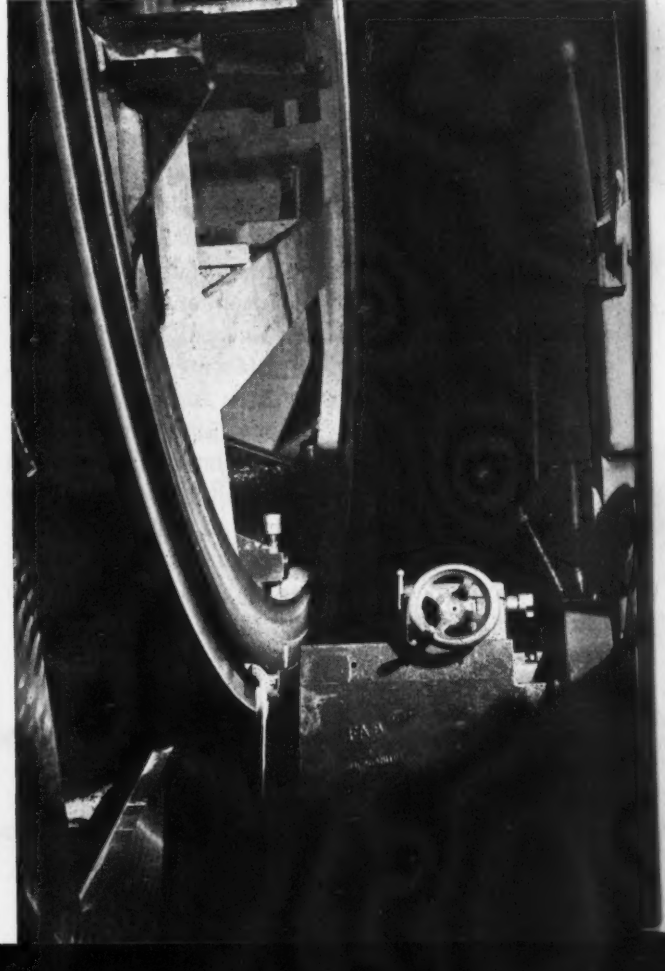
Fig. 9. (Below Left) Tooling Devised for Milling a Keyway for a Length of About 9 1/2 Inches in Bearing for Centering Post

Fig. 10. (Below Right) Turning a Ring on Bottom of Gun Base to a Diameter of Almost 10 Feet within a Tolerance of 0.001 Inch

involves the use of a right-angle milling attachment which is mounted on the headstock, as shown in Fig. 8. Equipped with an end-mill 1 inch in diameter by 2 1/2 inches long, this attachment is employed for rough- and finish-milling four ledges 2 inches in width and varying from 6 to 12 inches in length.

When the weldment leaves this boring machine, it is completely finished except for drilling and reaming several holes, operations which are performed under a radial drilling machine. Altogether, eighty-eight separate cuts are taken by the four boring machines—sixteen by the first, fifteen by the second, twenty-six by the third, and thirty-one by the fourth. Obviously, the use of the four boring machines for all operations except drilling and reaming eliminates the necessity of using a considerable number of large machine tools of different types and effects huge savings in work setting-up time.





Precision Electric Hardening of Naval Ordnance Parts

(*Continued from page 147*)

surface being hardened and the inductor as the work was fed past the inductor.

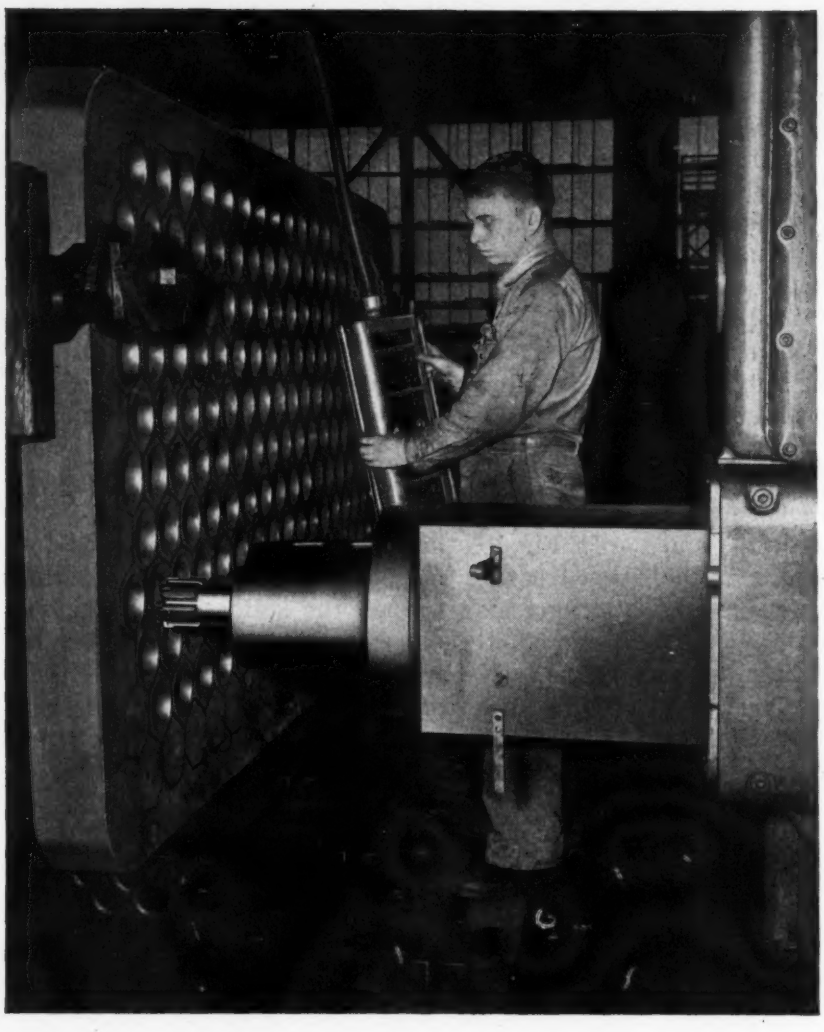
This problem was solved by mounting the work on a slide, which is automatically fed along a groove in a table as one of several pins mounted vertically on a chain drive pushes the slide along the table. The groove is machined to swing the work to and from the inductor as required to maintain uniform clearance between them. The cam surface being hardened is approximately 15 inches long by 5/8 inch wide. As the heated surface moves away from the inductor, it passes an integral spraying unit, which directs water on it at an angle away from the inductor. This method of heat-treatment has eliminated the carburizing and casehardening operation, as well as subsequent cleaning and straightening. A rubber apron placed over the motor as shown protects it from the quenching water.

Another set-up designed for handling shafts of any length is illustrated in Fig. 10. Tailstocks and headstocks with centers are mounted along a channel-iron support which is provided with bolt-holes for positioning the stocks as required to suit the length of the work. In loading a shaft on the centers, it is passed through an inductor mounted on one of the stations of the Tocco machine. After the work has been loaded, the channel-iron support is fed along the front of the machine through the medium of a rack and pinion drive to carry the work through the inductor from left to right. At the desired point, a micro-switch is actuated to turn on the electric current for heating. The heated surface is then carried through a circular water spray, which is directed at an angle away from the inductor. When the end of the surface being hardened reaches the inductor, the electric current is automatically turned off.

In Fig. 10 this fixture is being employed for heat-treating the splines of a shaft. Heating of the part starts when the splines reach the inductor and ceases when the opposite end of the splines is reached. This shaft is made of S A E 4640 steel and is surface-hardened to between 58 and 62 Rockwell C with practically no distortion occurring in the part.

Fig. 10. Arrangement Devised for the Automatic Induction Hardening Locally of Surfaces Along Shafts of Various Lengths

Negative-Rake Cutters



Two Operations in which Carbide-Tipped and High-Speed Steel Cutters Ground to Negative-Rake Angles Do the Impossible

By
CHARLES O. HERB

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SOME time ago the Navy Department issued orders that armor plate had to be closely checked for hardness at intervals of about one inch through the entire thickness at a point within the solid body of the plate, and not merely along external surfaces. To carry out this plan in a practical manner, it is necessary to obtain a solid bar or core of the armor plate which can be taken to the metallurgical laboratory and conveniently put through various tests.

At the Naval Ordnance plant in South Charleston, W. Va., that is operated by the Carnegie-Illinois Steel Corporation, a subsidiary of the United States Steel Corporation, the problem of obtaining such a rod or core was solved by the development of a special hollow drill of the type seen in Figs. 1 and 3. Experiments were first conducted with such drills having a high-speed steel cutting end brazed to a shank of ordinary steel, but the high-speed steel would not cut the hard top surface of the armor plate.

A similar tool was then made up with carbide tips mounted on a steel body and with the tips ground to conventional positive-rake angles. This tool also could not withstand the severe service demanded of it and the carbide tips were almost immediately fractured. Next another cutter was developed with carbide tips set to negative-rake angles. These tips were silver soldered to the steel body. It was found that the silver solder failed to secure the carbide tips as rigidly as required for good results. However, what was more important was the fact that the tips did not become broken as a result of the cutting pressure. A similar cutter was then made up with the carbide tips brazed to the steel body, and this tool proved completely satisfactory. A considerable number of duplicate tools have since been made for this difficult application.

These cutters are made with three inserts of Firthite T-04 carbide, which is a strong steel-

Hollow-Drill Armor Plate

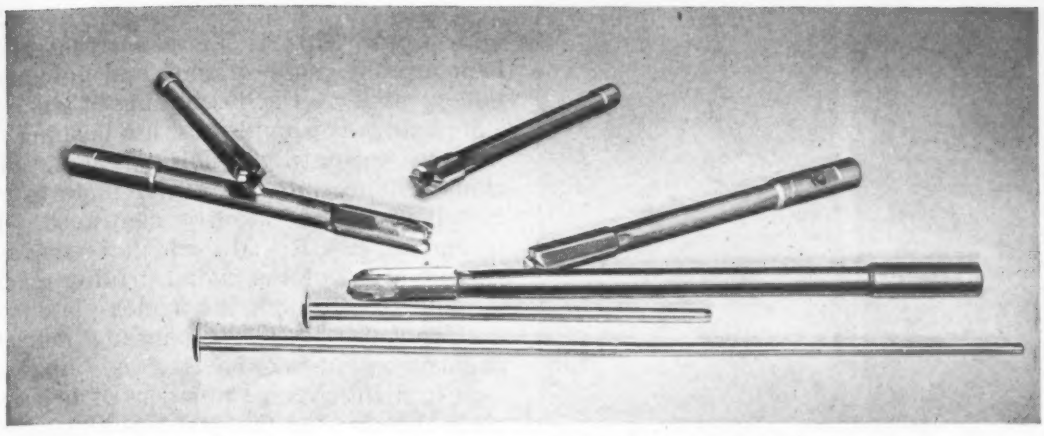


Fig. 1. Several of the Carbide-tipped Hollow Drills Used in Operations Such as that Shown in Figs. 2 and 3, Together with Two Typical Rods of Armor Plate that were Produced by Such Drills

cutting grade that withstands impacts and vibration to a considerable degree. The tips are positioned at a negative radial rake angle of approximately 6 degrees and a negative helix or axial rake angle of 3 degrees. The negative radial rake angle was determined by setting the inner end of the cutting edges 1/32 inch ahead of the center of the cutter. The tools are designed to cut to a diameter of 5/8 inch and produce a 1/4-inch core, the carbide blades being 3/16-inch wide. The hole in the tool is tapered for a distance of 1 inch back from the carbide tips so as to clear the rod or core being produced. The bits are 1/2 inch long by 1/8 inch thick.

In applying one of these drills on a radial drilling machine, as shown in Fig. 2, compressed air is delivered direct to the cutting edges to keep the tool cool and to blow chips from the hole. Generous flutes insure complete elimination of chips from the cutting edges. In Fig. 2, the armor plate is being drilled through the hard side. In the operation that is actually shown, the cutter was "touched up" twice in drilling to a depth of 8 3/4 inches, but no more sharpening was necessary for drilling through the remainder of the material. In Fig. 3, the core being obtained is still seen in the middle of the hole, while Fig. 1 shows two of the cores in front of the group of drills. Armor plate of light, medium, and heavy gages have been drilled in this manner.

In the background of Fig. 2 is seen a mag-

Fig. 2. Drilling a Hole through Armor Plate with a Hollow Tool to Obtain a Long Rod or Core of Armor Plate for Test Purposes in the Metallurgical Laboratory

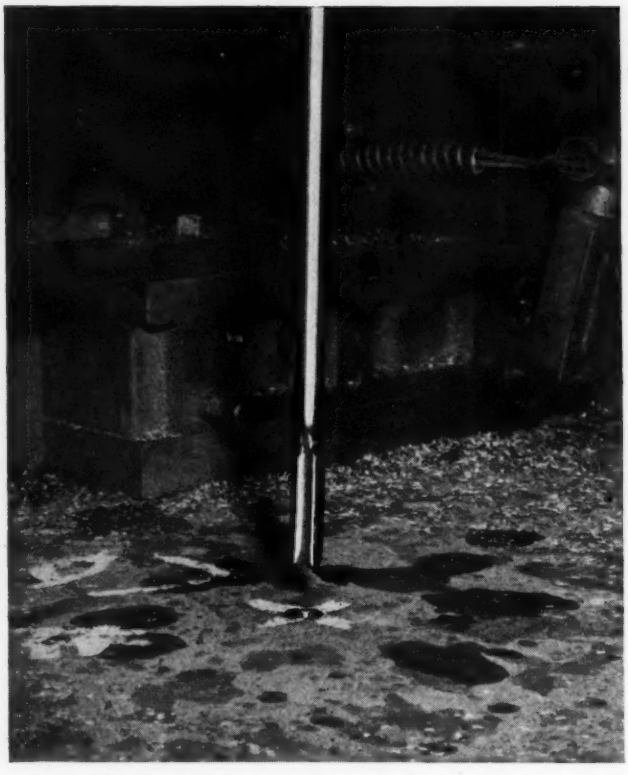


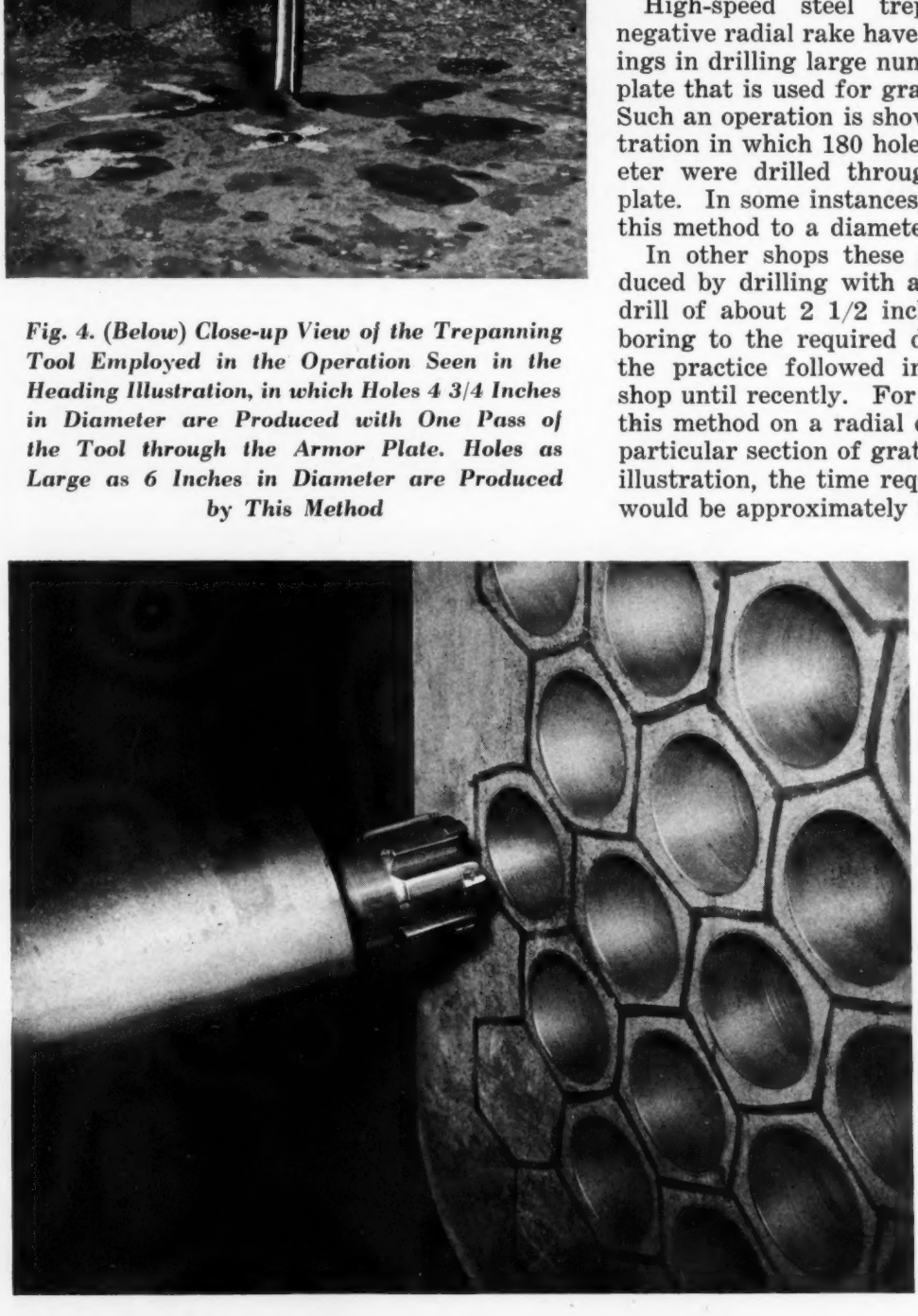
Fig. 3. Close-up View of the Armor Plate Drilling Operation, in which the Core or Rod of Material being Obtained can be Seen in the Hole

netic fixture that is placed on the armor plate to insure adequate support and guidance of the hollow drill at the beginning of an operation. This fixture is provided with a bushing for piloting the tool until the hole has been cut a sufficient distance into the armor plate to guide the cutter as the operation is continued. The drill is run at 660 R.P.M., which is the maximum spindle speed of the radial drilling machine. It is hand fed through the armor plate.

High-speed steel trepanning cutters with negative radial rake have effected huge time savings in drilling large numbers of holes in armor plate that is used for gratings aboard warships. Such an operation is shown in the heading illustration in which 180 holes 4 3/4 inches in diameter were drilled through 6-inch thick armor plate. In some instances, holes are produced by this method to a diameter as large as 6 inches.

In other shops these grating holes are produced by drilling with a high-speed steel twist drill of about 2 1/2 inches diameter and then boring to the required diameter, and this was the practice followed in the Carnegie-Illinois shop until recently. For producing the holes by this method on a radial drilling machine on the particular section of grating seen in the heading illustration, the time required for the operation would be approximately 320 hours. By employing the negative-rake trepanning cutter, the time is 50 hours, or only 15.6 per cent as long as previously. Fig. 4 shows a close-up view of the operation, while Fig. 5 shows one of the tools, together with a typical core that was cut out.

Fig. 4. (Below) Close-up View of the Trepanning Tool Employed in the Operation Seen in the Heading Illustration, in which Holes 4 3/4 Inches in Diameter are Produced with One Pass of the Tool through the Armor Plate. Holes as Large as 6 Inches in Diameter are Produced by This Method



The cutters used in these trepanning operations are made of 18-4-1 cobalt steel. They are made with a negative-rake radial angle which is dependent upon the inside and outside diameters of the trepanning cutters. In determining upon this negative-rake angle, a

lay-out is made similar to that shown in Fig. 6, in which *A* represents the outside diameter of the cutter and *B* the inside diameter. After laying out circles to correspond with these diameters, a circular center line is drawn midway between the two so that dimension *C* equals *B* plus *D*. Point *X* is next laid out on circle *C* at a distance *W* from the vertical center line of the diagram. This distance is made the same as *D*. A line is then projected through points *X* and *Y*.

A line drawn through point *Y* at right angles to line *XY* will correspond with the face of one of the cutting edges. Angle *Z*, therefore, will be the negative-rake radial angle of the cutter. In the case of the cutter used in drilling the holes in the grating seen in Fig. 4, the outside diameter is 4 3/4 inches, the inside diameter 3 inches, and the negative-rake radial angle approximately 13 degrees. If a positive radial rake were provided, the tendency would be to throw the chips toward the periphery of the cutter instead of into the flutes. The helical angle of the cutting edges is neutral.

In the operation here illustrated, the cutter is run at a speed of 28 R.P.M. and is fed 5/16 inch per minute. Cutting coolant is provided copiously through two holes 3/4 inch in diameter which lead from the shank to the front end of the tool.

So far, only high-speed steel cutters have been employed in these trepanning operations, as the rush of work during the war period has not allowed time for further experimentation with carbide cutters, but the opinion of the supervisory force and the machine operators is that even more spectacular savings could be effected with carbide cutters of negative-rake design.

* * *

Tocco Completes New Induction Heating Laboratory

A new high-frequency induction experimental laboratory has just been completed by the Tocco Division of the Ohio Crankshaft Co., Cleveland, Ohio. This is believed to be the most versatile and largest laboratory of its kind devoted solely to induction heating advancement. It covers 20,000 square feet of floor space and is equipped with twenty-four test heating stations supplied with 2000 kilowatts of power, having a frequency range varying from 960 to 1,000,000 cycles. The opening of the new laboratory coincided with the twenty-fourth anniversary of the founding of the Ohio Crankshaft Co., which was started in 1920 for the purpose of machining automotive and Diesel engine crankshafts and camshafts. It was in a search for improved methods of producing crankshafts that the Tocco induction process was developed twelve years ago.

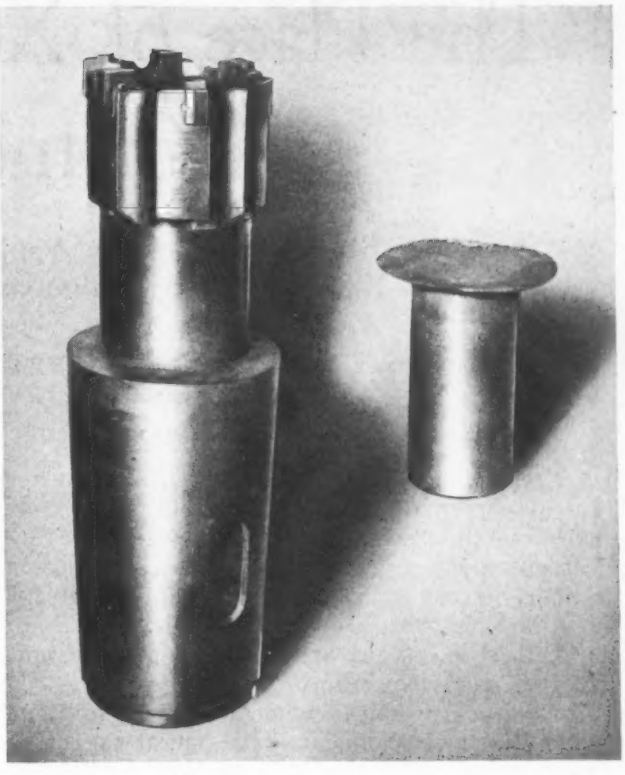


Fig. 5. Detail View of One of the Armor Plate Trepanning Cutters, Together with a Typical Core that is Produced with One Pass of the Cutter through the Work

Fig. 6. Typical Lay-out Made for Ascertaining the Negative Radial Rake Angle for Trepanning Cutters of the Type Shown in Other Illustrations

The Place of X-Ray Equipment in Industry

A Brief Review of the Applications of Recently Developed X-Ray Inspection Equipment in the Mechanical Industries

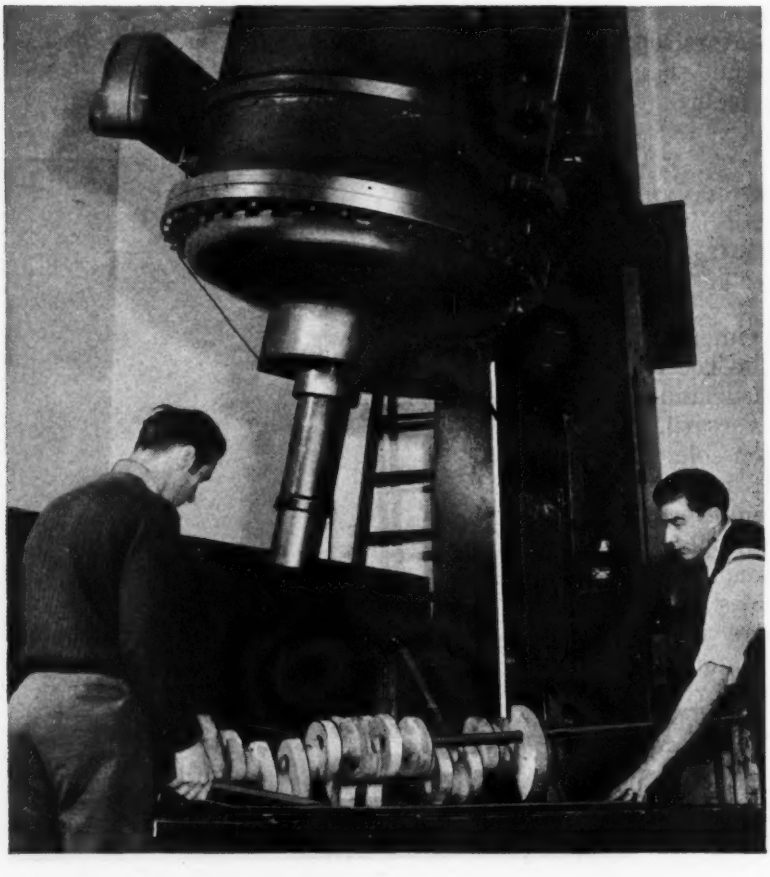
By JOHN L. BACH
General Electric X-Ray Corporation, Chicago, Ill.

AN electron is the smallest particle of matter —so small that 30,000 trillion trillion weigh less than an ounce. Yet, these tiny electrons today are speeding up the construction of nearly every type of fighting equipment for the Allied Nations. In war plants from coast to coast, these electrons are playing an important role in X-ray inspection.

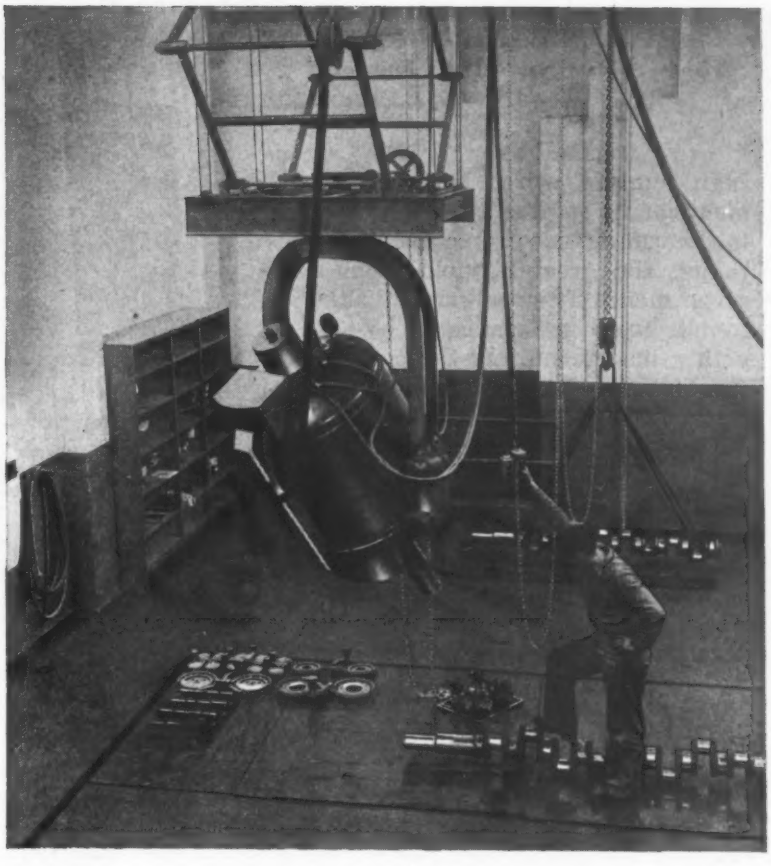
X-rays are produced when electrons, millions and millions of them, strike a metal target at terrific speed. The rays that are given off penetrate solid substances and produce a shadow picture on photographic film. The developed film shows any defects in the object being X-rayed. In aircraft, tank, and other industrial plants, in arsenals, steel mills, and shipyards, the X-ray now reveals the hidden air bubble, crack, or structural flaw that might spell death to those who depend upon unfailing battle equipment, or might cause failures of important machines.

The use of high-voltage X-rays in industry is not new, nor is it a direct development of the war. Engineers have been checking welds by radiography for several years with 400,000-volt machines. X-ray inspection of naval turbine castings has been an accepted practice for some time past. Until only a short time ago, however, most high-voltage machines have been big, cumbersome affairs, often requiring special multi-story buildings to house them. Moreover, while they were, and still are, highly effective for jobs like weld inspection, they required long exposures and were limited to penetrations of about 5 inches.

The new and compact 1,000,000-volt industrial X-ray unit is less than 5 feet high and 3 feet in diameter, and weighs about 1500 pounds. Hanging from a flexible bridge crane, this unit can penetrate 8-inch plates of steel, and inspect, in sixteen minutes, pieces of metal that previously required sixty hours. Such units are in operation at Navy Yards in Norfolk, Philadelphia, Pearl Harbor, and Boston, and in many industrial plants making war equipment; they are used for the high-speed radiographic inspection of heavy metals. X-rays reveal such faults as blow-holes, tears, shrinkage cavities, inclusions, and cracks —faults which cannot be detected by the keenest eyes and which cannot be tolerated in high-pressure turbine castings or in ordnance



A 1,000,000-volt Industrial X-ray Unit for Radiographing Ford V-8 Tank-engine Crankshaft Castings



Another 1,000,000-volt X-ray Unit, Mounted on an Overhead Bridge Crane. A 5 1/2-inch Welded Plate can be Radiographed in 10 Minutes with This Unit as Compared with the 7 1/2-hour Exposure that was Formerly Required

equipment. Steels and ferrous alloys are inspected, as well as welded structures and thick aluminum alloys.

Several 1,000,000-volt units now in operation inspect heavy boiler drums. Before these units were installed, the welds in heavy drums having plate thicknesses of from 3 inches to 5 1/2 inches were radiographed with the 400,000-volt industrial X-ray unit. The time required for complete radiographic examination of a heavy pressure vessel by this method required days. Using the 400,000-volt unit, a circumferential seam in a 6-foot diameter drum, having a plate thickness of 4 1/2 inches, required approximately three hours per exposure. If thirty separate exposures were necessary to complete examination of the entire drum, about four full days were needed. Using the 1,000,000-volt unit, the time for each exposure was cut from three hours to approximately ten minutes. Thus it is evident that many hours of production time are saved, with prospects of greater X-ray developments after the war.

By using the 1,000,000-volt "candid camera" to examine cast-steel aircraft-engine crankshafts, engineers have reduced by more than one-sixth the man-hours formerly required for the test. Not so long ago, checking a casting for a heavy bomber part required six exposures. The 1,000,000-volt unit has reversed the figures, now checking six castings with one exposure.

The aircraft industry finds radiographic examination of aluminum, magnesium, and other parts indispensable for locating possible flaws, and even as a means of helping to determine the design of certain airplane parts. One great advantage is that the examination is non-destructive and does not injure the objects tested. Without industrial radiography, many aircraft parts would have to be made heavy enough to allow an additional factor of safety because of the possibility of flaws. However, when every specimen containing flaws can be identified and discarded, this extra factor of safety can be reduced. Sometimes it is not enough to know merely that a defect is present. The exact location and extent of the flaw may provide information which will enable the workers to repair instead of reject the part. Production can be speeded up by quickly determining the extent and nature of defects.

At the Buick aviation plant near Chicago, a 220,000-volt General Electric X-ray unit radiographically inspects cylindrical bronze aircraft-engine bearings. The total inspection time required to completely X-ray forty bearings was reduced from approximately five hours to ten minutes.

Cooperative Use of X-Ray Equipment for Industrial Purposes

The University of Rochester makes use of a 1,000,000-volt X-ray unit in cooperation with twenty Rochester industrial concerns for the rapid examination of armor castings, welded parts, and bronze and aluminum castings. It has set up at low cost a direct and practical service for industry. One of the University's first jobs called for the radiography of completely machined finished assemblies. The X-ray showed that the assembly was faulty in a vital zone, with the result that the company had to discard for scrap, at 25 cents per unit, a product on which they had spent $25 to $27 for machining. The University technicians found that 80 per cent of the company's 1200 units were defective. If the firm had resorted to X-ray examination before machining, this loss need not have occurred.

A General Electric Industrial X-ray Unit that Automatically Checks Hand-grenade Fuses at the Rate of 4000 an Hour

In foundry work, X-ray equipment can be used as a research tool to determine the proper technique to get the greatest yield from a given melt. The designer and the foundryman use radiography together in determining the best design for the casting and the best way of producing it.

New fluoroscopic X-ray units permit production line inspection of aluminum and magnesium castings. One of the first such units was used to check the amount of powder in hand-grenade fuses, which was essential in order to prevent explosions premature to the set time. It automatically checks fuses at the rate of 4000 an hour.

Of all the war plants throughout the country, Ford is the largest user of X-ray industrial equipment, providing radiation at voltages of from 5000 to 1,000,000. This covers the entire range of industrial radiography, from the study of very thin samples by microradiography to inspection of steel castings 8 inches thick.

More than 125 persons are employed in the various Ford X-ray departments. In order to utilize all the apparatus to the fullest extent, the company maintains an apprentice training school to teach civilian operators how to handle X-ray equipment and process films. A 140,000-volt industrial X-ray unit is used for training purposes, and everyone who has to handle X-ray equipment is well qualified to do his job before he takes over his assignment.

Ford has two 1,000,000-volt industrial X-ray units for routine inspection. In sixteen minutes the same number of parts are passed as in sixty hours with low-powered apparatus. One of these units is in the aircraft engine building at the River Rouge plant and the other is in the new steel foundry.

As a basis of comparison, Ford engineers have found that the 1,000,000-volt unit can examine sixty-four times the volume formerly X-rayed with their 400,000-volt unit, and twenty-four times the volume possible with radium of average amount in the same floor area and with the same handling facilities.

Inspecting Crankshafts in the Ford Plant

Every crankshaft built into a Ford V-8 tank engine undergoes radiographic inspection with the 1,000,000-volt unit. Each crank-

Semi-automatic Industrial X-ray Unit that Provides Rapid and Accurate Production Line X-ray Examination of Light Alloy Castings

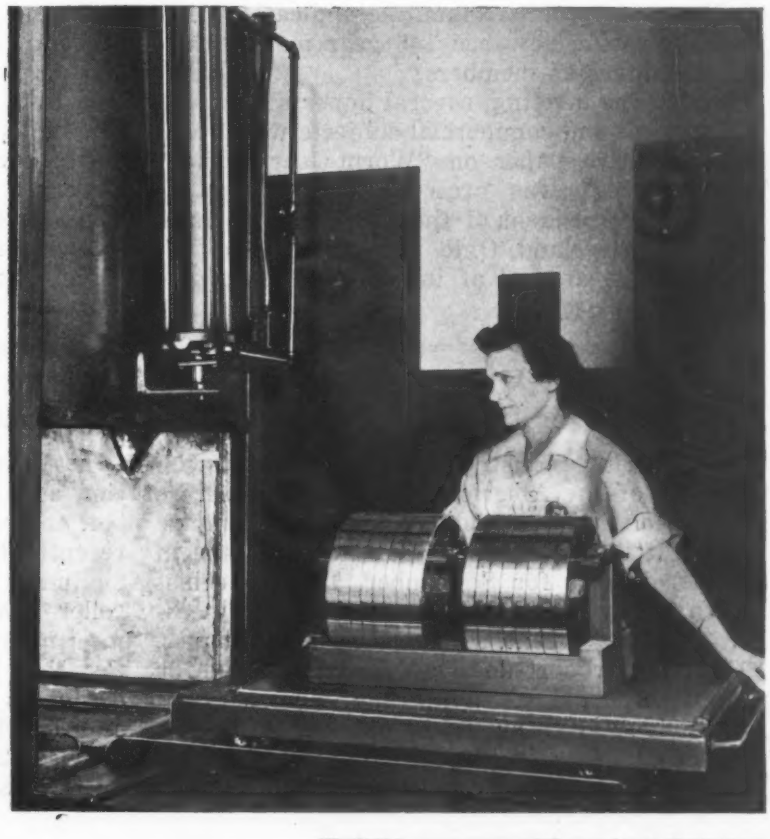
shaft is 3 feet in length and weighs about 250 pounds. To speed up examination, Ford technicians ingeniously designed a wooden fixture so that twelve of the big crankshafts could be X-rayed at one time. They are fitted into the fixture and it is placed on a large lead-covered truck operating on tracks.

Three different exposures are taken from different angles. The films in cassettes are placed in racks under the fixture in which the crankshafts are suspended. The cassettes slide out quickly for changing. It requires thirty-four minutes to X-ray all twelve crankshafts from one direction. Another eighteen minutes each is necessary to radiograph separately two groups of six crankshafts from a different angle. These two exposures take thirty-six minutes; or a total of seventy minutes is needed to completely radiograph all twelve crankshafts. After the films are developed in a large darkroom near by, any defective crankshafts are removed from the lot for salvage, and the others are stamped with a star showing that they have passed X-ray examination.

Structure of Materials Studied by Means of X-Rays

Industry has found in the X-ray, also, new knowledge of the structure of matter. The X-ray sees, by "diffraction," what the microscope cannot see. The physicist places in a "camera" a sample to be studied, and directs at it a beam of X-rays. The sample diffracts the rays, and the diffracted radiation creates a pattern on sensitized film. The physicist simply reads the diffraction pattern, and by calculation can determine what structural changes occur when metal is rolled. He can classify cotton, wool, silk, and other natural and synthetic fibers according to strength; and he can even classify the minerals in rhubarb!

Many unusual applications of X-rays have been made in connection with war production, applications that will become generally useful in the peacetime industries. X-ray inspection is likely to become an everyday tool in post-war mechanical practice.



Cam Rings for Aircraft Engines are Radiographed by Using a 220,000-volt X-ray Unit. A Rack of Cam Rings is Made Ready for Placing It in the X-ray Cabinet. The Workers are Protected from the X-rays by Pneumatically Operated Doors

The Value of Coolant Filters for Grinding Machines

According to W. T. Friess, chief engineer of the Majestic Tool & Mfg. Co., Detroit, Mich., experiments conducted by his company with Briggs coolant filters have proved that substantial increases in production can be made when the grinding coolant is properly filtered. According to Mr. Friess, before installing the filter, the coolant had to be changed as often as two or three times a day. Now it can be used for a whole week or until it becomes rancid. In a specific case, the time thus gained increased the average production from 18 to 20 pieces per hour, or approximately 10 per cent. Furthermore, the percentage of rejections has been reduced to one-fifth of what they were before the coolant filters were used, and the finish obtained on the work is better.

As a result of this experience, the Majestic Tool & Mfg. Co. is installing oil filters on all machines in its plant, and is also furnishing filters as standard equipment on machines manufactured by the company.

* * *

Plastic helmets have been developed to a considerable extent during the war. Miners' safety helmets, firemen's head guards, and sun helmets are now being made from plastics. A lining for combat helmets is also made from this material.

Gear Manufacturers Hold Active Meeting in Chicago

THE American Gear Manufacturers Association's meeting held in Chicago, Ill., October 30 to November 1 was attended by a larger number of members than any previous meeting of the organization. As usual, a great deal of the time was given over to a consideration of standardization problems. The Society has been a leader in the field of standardization in gear design and is maintaining this activity to the fullest extent.

Louis R. Botsai, President of the American Gear Manufacturers Association

The meeting was opened by the president of the organization, Louis R. Botsai, manager of the Gearing Division of the Westinghouse Electric & Mfg. Co., who spoke on some of the post-war problems that face the industry and on the necessity of preparedness for the peace years to come. Following this address, the various administrative committees presented their reports, the one by the membership committee indicating that the Association now has 145 gear manufacturing companies as members.

During the meeting, several important papers on technical and commercial subjects were read. An exhaustive paper on "Worm-Gear Contact Temperatures" was presented by George H. Acker, vice-president of the Cleveland Worm & Gear Co., Cleveland, Ohio. Another paper that aroused a great deal of interest was that prepared by Lieutenant Alfred J. Kroog of the U. S. Navy and Richard W. Righter, engineer of the Navy Department, who described experiments undertaken with the use of carbide hobs for cutting marine propulsion gears. These experiments are still being continued, and the paper presented before the Association was in the nature of a progress report; but enough was brought out to indicate that the use of gear-cutting hobs with cutting teeth made of carbide materials has great possibilities.

F. C. Rushing of the Westinghouse Research Laboratories, read a carefully prepared paper on "Vibration Problems in Engineering." The business side of the industry was given attention in a paper by Lieutenant Colonel Francis W. Parker of the U. S. Army, who spoke on "Contract Termination and Settlement."

To indicate the wide interest in the various standardization topics dealt with by the Association, it may be mentioned that meetings were held by the committees on inspection, fine-pitch gearing, helical and herringbone gearing, keyways, bevel gearing, oil-field gearing, gearing materials, splines, spur gearing, gear lubrication, gear service manual, aircraft gearing, tooth forms, hobs, transmission gearing, gear sound, nomenclature, and high-speed gearing.

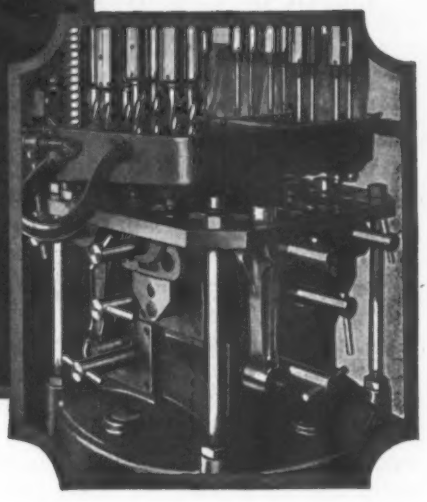
Demand for Gears Still Increasing

The gearing industry, as represented by the members of the American Gear Manufacturers Association, with headquarters in the Empire Bldg., Pittsburgh 22, Pa., shows an increase in volume of sales for September, 1944—the last month for which complete statistics are available—of 0.3 per cent, as compared with August, 1944. This report does not include turbine or propulsion gearing. While the increase over August is small, it should be noted that the volume of business in the gearing industry has been steadily at a very high level.

Reclaiming Ball and Roller Bearings

A national program calling for the reclamation at Army Air Force Depots of millions of ball and roller bearings for military aircraft has recently been developed by Army Air Force engineers and representatives of the ball and roller bearing industry. A five-day technical meeting, held at the plant of the Fafnir Bearing Co., New Britain, Conn., which was attended by engineers of the ball and roller bearing industry and bearing specialists of the Air Technical Service Command made the joint announcement on the possibility of reclaiming these bearings.

Design of Tools and Fixtures



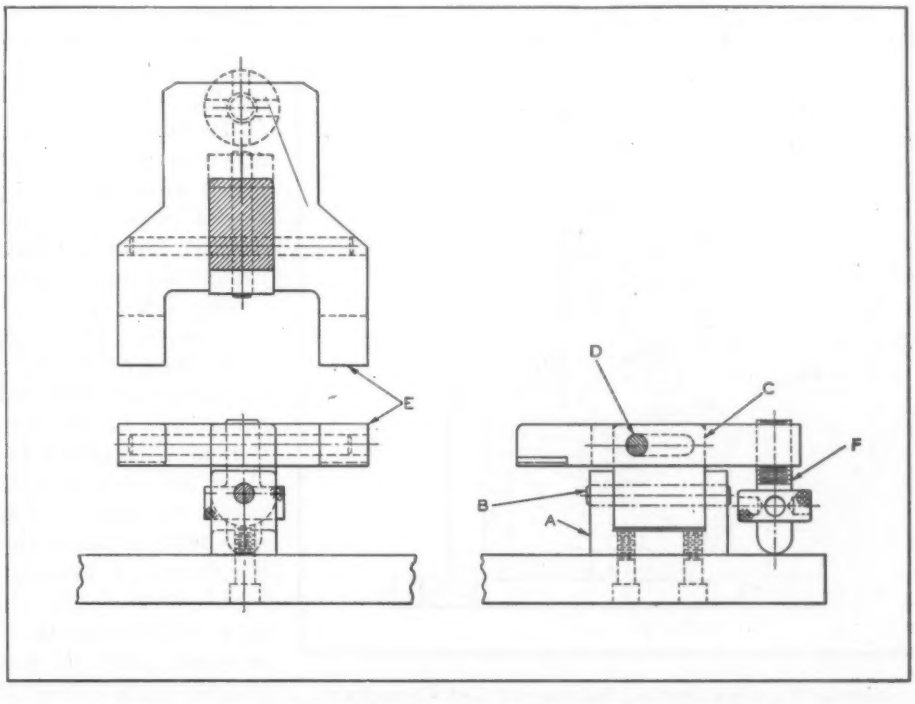
Sliding Type Two-Way Equalizing Strap Clamp of Compact Design

By EDWARD LAY, Chief Tool Designer
Fairchild Camera & Instrument Corporation

Designing holding devices for the machining of castings for light but accurate instruments requires close observance and careful attention to details. The first operation on any casting is usually the most critical one, and one for which standard strap clamps do not always provide the best means for holding the work. An unfinished surface can never be of uniform thickness, and for this reason the ordinary clamp will exert more pressure on the highest point while hardly touching the casting at other points. This condition naturally results in many sprung and inaccurately machined castings that must be sent to the scrap pile.

A clamp which incorporates all the essential features required for solid distortionless clamping is shown in the accompanying illustration. The actual shape of the clamp can be varied to suit the shape of the casting to be machined; but as long as the principal parts retain their functional characteristics, this type of clamp can be applied to a wide variety of work.

Referring to the construction of the clamp, the U-shaped part *A* comprises the base for the clamping unit. Pin *B* mounted in this member serves as a pivot in the lower end of part *C* for the horizontal equalizer. The upper end of part *C* is slotted to fit pin *D*, in order to facilitate sliding strap *E* back and forth simultaneously with up and down movements as required for convenient loading and unloading. The clamp-actuating screw *F* is inverted to permit unobstructed movement of the fixture below the cutting tool. A rod inserted in one of the radial holes drilled in the knurled collar of screw *F* can be used as a lever to facilitate tightening or releasing the clamp.

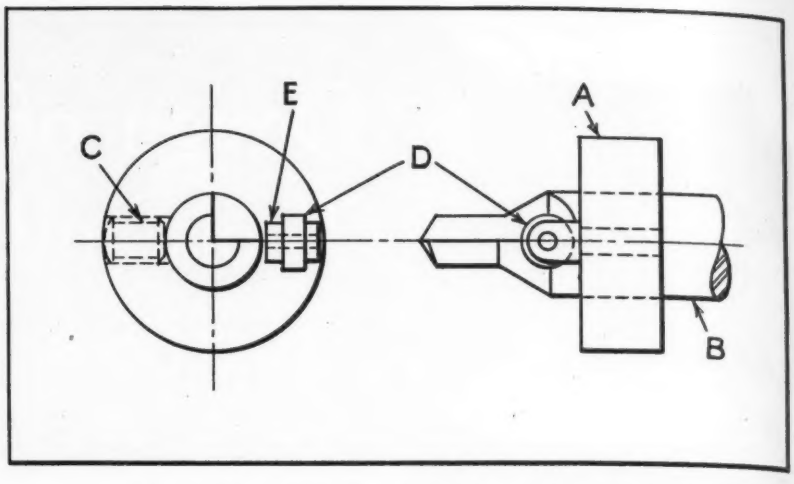


Two-way Equalizing Sliding Strap Clamp of Compact Design

Device for Regulating Depth of Countersink

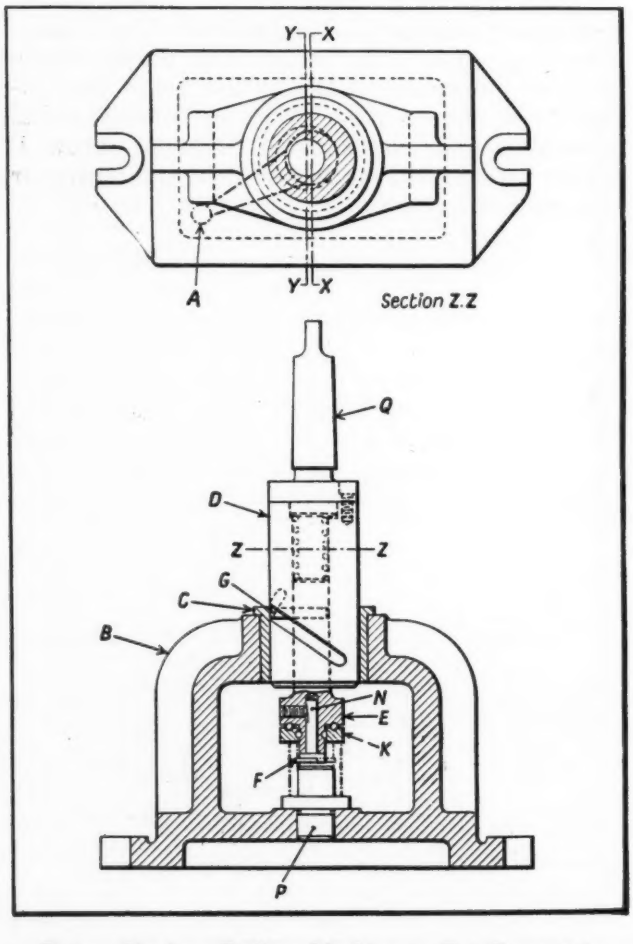
By B. J. STERN, New York City

Recently our shop was required to produce several hundred steel shafts which had to be machined to exact diameters and lengths. These shafts were squared on the ends, center-drilled, and then mounted in a lathe for the various facing and turning operations. By using the device shown in the accompanying illustration, it was possible to hold the countersunk centers in all the shafts to exactly the same depth. This insured uniform longitudinal positioning of the shafts between the lathe centers and permitted the apron stops on the lathe to be used to insure accuracy and a high rate of production.



Countersink Equipped with Depth Regulating Device

Referring to the illustration, collar *A* on the center drill *B* can be adjusted and locked in place by the set-screw *C*. Projecting from the collar *A* is a small wheel *D* that revolves on a pin in the yoke *E*, which is threaded to fit a tapped hole in the collar. As is evident from the illustration, the wheel can be set to stop the countersink at any desired depth and will revolve on the face of the work when this depth is reached.



Fixture Used on Drilling Machine to Cut Concentric Recess in Bore of Lever Hub

Fixture for Cutting Recess in Bore of Lever Hub

Cutting a recess in the bores of forged steel lever hubs has been simplified by using the special fixture and recessing tool shown in the accompanying illustration. The cast-iron base *B* of the fixture is designed for mounting on the table of a single-spindle drilling machine. The shank *Q* of the recessing tool is made to fit the socket in the drilling machine spindle. With this equipment the recessing operation is reduced to the simple procedure of placing the work, shown by dot-and-dash lines at *A*, on the locating plug *P*, feeding the drill spindle attached to shank *Q* downward to the end of its stroke, and returning it to the starting position. After cutting the recess in this manner, the work can be removed quickly from the fixture, which is then ready to repeat the operation on another piece.

The illustration shows the recessing tool in the position it occupies at the end of its downward feeding stroke, at which point the cutter *F* has been fed outward a sufficient distance to cut the recess to the required depth. The cutter *F* is next withdrawn from the recess so that it will clear the bore in the work during the initial upward movement of the machine spindle.

It will be noted that the work is held down on the flange of locating plug *P* by a plate *K* on the tool-holder *E*, the shank of which is backed up by a helical spring. The ball bearing interposed between plate *K* and the tool-holder takes the thrust from the spring while plate *K* is in contact with the work. As long as the drilling ma-

chine spindle remains in the down position cutter *F* will revolve in the recess cut in the work, but when the upward movement of the spindle begins, the cutter also begins to withdraw from the recess. As body *D* attached to shank *Q* begins its upward movement, plate *K* is kept in contact with the work by the action of the helical spring.

A pin in the shank of holder *E* which extends through helical cam slot *G* in body *D* causes the holder *E* to rotate within body *D*. Since the shank of holder *E* is located on center line *Y–Y*, which is off center with respect to the center line *X–X* of the body *D* and the machine spindle, the cutter *F* will travel along an eccentric path with respect to the center of the bore in the work until it is entirely clear of the recess. Rotation of holder *E* within the body *D* stops when the bottom of slot *G* comes in contact with the pin in the shank of the holder. The pin then takes the thrust exerted by the helical spring so that continued upward movement of the machine spindle raises plate *K* from the work. The upward movement of the machine spindle is continued until the tool has been raised sufficiently to permit removal of the work. A new piece of work can then be placed on the locating plug *P* and the downward feeding of the spindle started with a minimum of lost time.

On the downward movement, the retracted cutter *F* enters the hole in the work and is stopped in the correct position for cutting the recess by contact of collar *K* with the top face of the work hub. Continued downward movement causes body *D* to move down over the shank of holder *E*, compressing the helical spring. The cam slot *G* acting on the pin in the holder shank, causes the holder *E* to rotate within body *D* and swing the tool outward until it has cut the recess to the required depth. S. S.

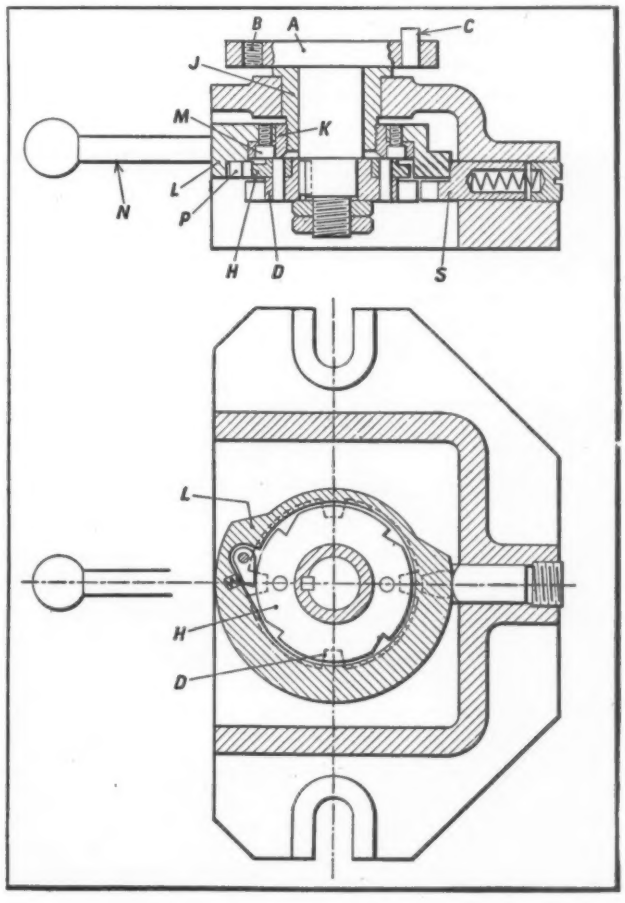
General-Purpose Indexing Table

A general-purpose indexing table designed to accommodate a number of interchangeable work-holding jigs or fixtures used in machining parts for internal combustion engines is shown in the accompanying illustration. Tapped holes *B* and a dowel-pin *C* are provided for use in locating and fastening the interchangeable jigs or fixtures on the indexing table *A*. Some of the fixtures are made a push fit over the periphery of table *A*, on which they are located by dowel *C*. The index-plate *D* is located on the lower end of the table arbor by a key and is retained by two lock-nuts. Ratchet plate *H* is mounted on the hub of index-plate *D*, on which it is located by dowels.

The liner *J*, in which the table pillar rotates, has an external thread at its lower end which engages the locking ring *K*. Ring *K* is actuated by the cam ring *L* operated by lever *N*. Four counterbored holes in ring *K* and six tapped holes for studs *M* in cam ring *L* permit making adjustments to compensate for wear on the locking ring. The spring-loaded pawl *P* mounted in the cam ring *L* serves to operate the indexing mechanism. The rise on the cam ring *L* is designed to disengage the spring-backed locating plunger *S* during the indexing movement.

When in the normal working position, table *A* is located by the plunger *S*, which engages one of the indexing notches in plate *D*. The table is clamped securely in this position by moving the operating lever *N* clockwise to the locking position. This locking action is obtained by means of the thread on the table arbor which forces the locking plate *K* against plate *H*.

To unlock the table, lever *N* is moved counterclockwise in the indexing direction, causing the locking plate *K* to release the clamping pressure on plate *H*. Further movement of the lever causes the cam lobe on ring *L* to disengage the locating plunger *S* from the index plate *D*, thus leaving the table free to rotate. When plunger *S* is fully withdrawn, the pawl *P* is forced into engagement with the ratchet plate *H*, and lever *N* is moved sufficiently to index the table *A* into



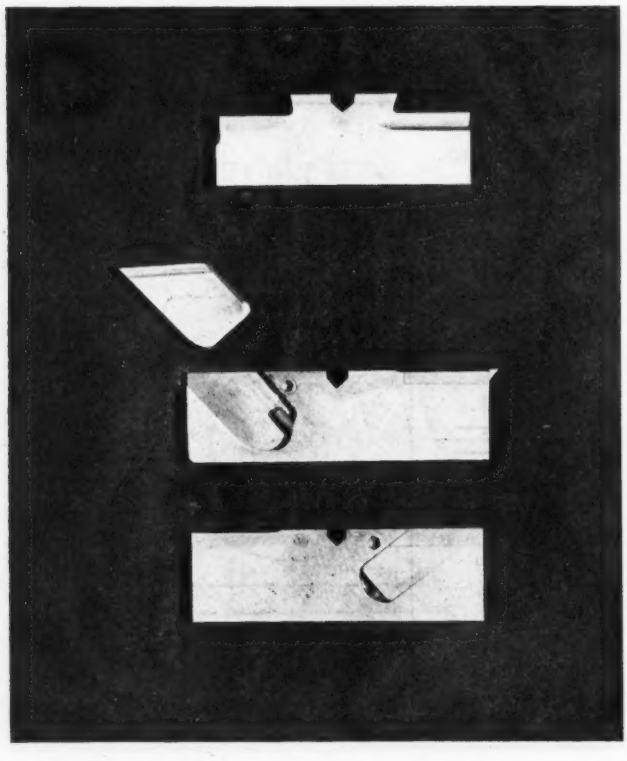
Indexing Table Designed to Accommodate Interchangeable Work-holding Fixtures on Table A

the required position. An adjustable stop, not shown, is provided to insure rotation of the table to the correct position when lever *N* has reached the end of the indexing movement. B. M.

Adjustable Facing Cutters

The new adjustable facing cutter shown in the illustration was devised by Patrick L. Richards, a boring mill operator at the General Electric Co.'s Pittsfield Works, for use in boring-bars employed on horizontal boring mills. The cutter consists of two blades inserted in diagonal grooves machined in the ends of a holder and set-screws that pass through the holder into the grooves in such a way that they can be used to adjust the blades. The blades are securely locked in position by pressure applied from off-center circular clamps built into the holder.

Two or more of the new type cutters can be used in the same boring-bar to insure maintaining definite dimensions between the surfaces faced by the cutters. It was difficult to do this with the old type cutters because when one cutter became dull it was necessary to sharpen all of the cutters in order to maintain the required dimensions. The use of the new adjustable cutters eliminates the necessity for such sharpening operations. When a blade becomes dull, it can be removed from the holder, sharpened, reset in the groove, and adjusted slightly by a set-screw to bring it back to its previous correct setting in relation to the other cutting blades on the boring-bar.



Boring-bar Facing Cutters that can be Adjusted to Compensate for Changes Caused by Sharpening

The life of the conventional type cutters was very limited due to constant sharpening; and when the cutting surface was completely ground away, the tool had to be discarded. With the adjustable type, however, only the cutting blades need to be replaced when they become worn from sharpening. Thus considerable tool steel is conserved and tool maintenance costs are reduced.

* * *

High-Speed Copper-Plating Process

An improved copper-plating process that reduces operating costs and speeds up production rates has been announced by E. I. du Pont de Nemours & Co., Wilmington, Del. This improvement is a development of the copper-plating process introduced by the Electroplating Division of the company in 1938. The original method produced heavier deposits of copper in a shorter time than had been possible previously. It utilized a carefully compounded and controlled sodium copper cyanide bath operating at 100 per cent current efficiency and at increased current densities.

The new gains have been achieved by working out a method of substituting potassium cyanide and other potassium salts for the sodium salts formerly used, with still further increases in current densities. Development of methods for producing the potassium salts in this country and technical advances in their use in plating baths made the substitution possible. Of major importance among war applications of copper-plating is its use as a stop-off or mask in the selective casehardening of steel parts to increase wear resistance.

* * *

Silver as a Substitute Metal

Manufacturers who have difficulty in obtaining copper, brass, stainless steel, and other materials that are definitely on the priority list may be able in many instances to use silver as a substitute. There is a sufficient amount of silver available, and its cost is not prohibitive for many purposes. Silver is easily worked, and can be obtained in the form of sheets, strips, rod, tubing and wire. A large number of silver alloys for different purposes are also available. High corrosion resistance and high electrical and heat conductivity are important characteristics of silver for industrial application. Those interested can obtain additional information from the American Silver Producers' Research Project, 82 Fulton St., New York 7, N. Y.

Annual Meeting of Machine Tool Distributors' Association

THE twentieth annual meeting of the American Machine Tool Distributors' Association, having headquarters at 505 Arch St., Philadelphia 6, Pa., was held at the Homestead Hotel, Hot Springs, Va., Monday and Tuesday, November 13 and 14, with A. M. Stedfast, of Stedfast & Roulston, Boston, Mass., president of the Association, presiding. A number of papers of interest to both machine tool manufacturers and dealers were read at the meeting, in addition to the reports presented by the various committees.

Among the papers presented should be mentioned "Present Activities of the Tools Division," by John S. Chafee, director of the Tools Division of the War Production Board, Washington, D. C. Commander E. A. Ewing of the United States Navy, who is chief of the Machine Tool Section of the Navy Department's Office of Procurement and Material, spoke on "Mobilization of Machine Tools for War." Some interesting facts relating to present policies in Washington were presented by Paul Wooton, Washington representative of the McGraw-Hill Publishing Co., who had chosen as his subject, "What I am Hearing in Washington."

An important address on the relation of present Government policies to the machine tool industry was given by A. G. Bryant, president of the Bryant Machinery & Engineering Co., Chicago, Ill., who spoke on "The Washington Situation," dealing with a number of problems that must be solved by the industry in accordance with policies determined by the Government. This address was followed by an open forum on "Renegotiation," which was led by A. B. Einig of the Motch & Merryweather Machinery Co.

A tribute to the machine tool industry was voiced by Brigadier-General Frederick M. Hopkins, Jr., in his address, "An Air Force Salute to the Machine Tool Industry." At the annual dinner, Rear Admiral Clark H. Woodward of the United States Navy, chief of the Incentive Division of the Navy Department, spoke on "Japan—Our Toughest Wartime Problem." At this time an unusual motion picture, "Return to Guam," was also shown.

The following officers were elected to serve for the ensuing year: President, A. B. Einig, Motch & Merryweather Machinery Co., Cleveland, Ohio; vice-president, George Habicht, Jr., Marshall & Huschart Machinery Co., Chicago, Ill.; second vice-president, D. N. Macconel, Machinery Sales Co., Los Angeles, Calif.; and secretary-treasurer, C. C. Brogan, W. E. Shipley Machinery Co., Philadelphia, Pa.

New Bright Alloy Plate

A NEW bright alloy plate, developed in the laboratories of the Westinghouse Electric & Mfg. Co., has been used with success as a protective coating on many electrical products. The coating consists of an alloy of copper, tin, and zinc. The outstanding property of this bright alloy coating is its corrosion protective value when applied over copper or brass. It is possible for a thickness of 0.0002 inch to withstand a 200-hour salt spray test with little or no corrosion on the surface.

In actual tests it has been found that 0.0002 inch of the bright alloy deposit gives as much protection as 0.0005 inch of nickel. The alloy is relatively brittle in heavy coatings, however, and is seldom used in thicknesses over 0.0005 inch. It is harder than nickel and its wear resistance is superior to normal nickel deposits.

Since the bright alloy is non-magnetic in an electrical field, it is an especially desirable coating for certain electrical equipment. It is also suitable for both decoration and protection of fine instruments. When a mirror-like surface is required, the alloy deposits can be colored more readily than nickel, and its reflectivity approaches that of silver.

The Hanson-Van Winkle-Munning Co., Matawan, N. J., is sole agent for the process in industry.

* * *

Simplified Practice for Files and Rasps

The National Bureau of Standards has just published a "Simplified Practice Recommendation (R6-44) for Files and Rasps." This recommendation is available in booklet form from the Superintendent of Documents, Washington 25, D. C.; price, 10 cents.

Engineering News

Disintegration Method of Removing Broken Taps and Other Tools

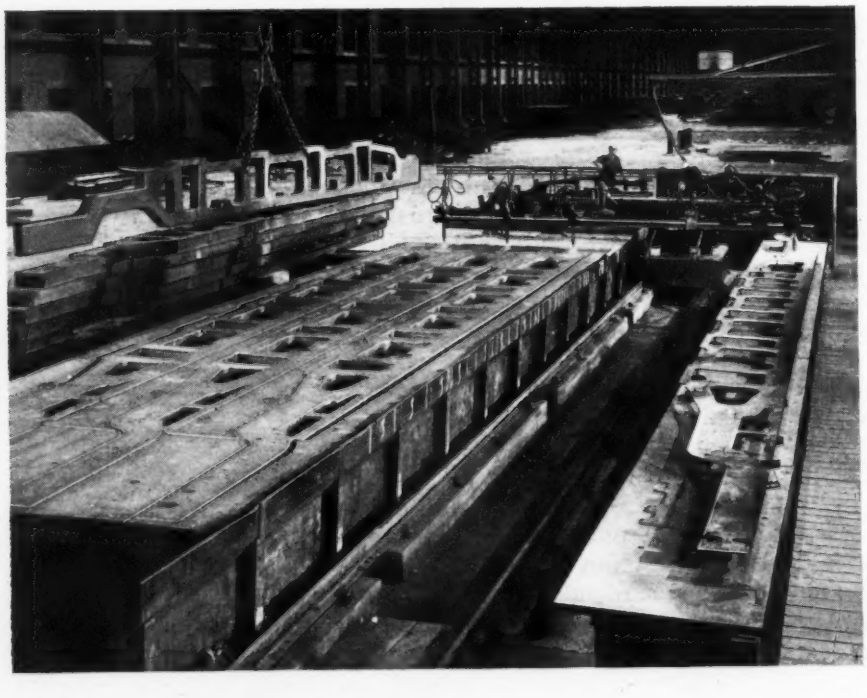
An unusual development for removing broken taps and other tools from forgings and castings has recently been introduced. The Drafto Corporation, Cochranton, Pa., has placed this tool on the market under the name of the "Metal Disintegrator." The equipment has an appearance somewhat like that of an electric drill. The disintegrator head is mounted in a drill press or other device having vertical travel. The work with the imbedded tool that is to be removed is centered under the electrode of the device; a ground cable and arc-coolant tubing are attached. A vibrating mechanism within the head makes and breaks an electric arc between the electrode and the broken part, causing disintegration of the tap or other tool without excessive heat and without damaging the workpiece by distortion or otherwise.

X-Ray Pictures Taken through Steel a Foot Thick

X-ray pictures can now be taken through pieces of steel 12 inches thick by means of a new 2,000,000-volt mobile X-ray unit developed by the research laboratory of the General Electric Co. This is double the X-ray voltage previously available to industry for the examination of metal sections to discover defects. Up to the present time, the most powerful X-ray units in general use have been 1,000,000-volt equipment. More than fifty of these 1,000,000-volt units are now actively serving in the war effort in the United States and abroad. The new 2,000,000-volt X-ray unit makes a satisfactory exposure through a 12-inch slab of steel in about two hours when Type A X-ray film is used at a distance of 3 feet from the end of the tube.

New Machine Speeds Inspection of Metal Lamp Bases 400 Per Cent

A new inspection machine, designed by Westinghouse engineers and operating at the Westinghouse Lamp Division plant at Belleville, N. J., is said to speed the inspection of metal lamp bases as much as 400 per cent. Formerly, the inspectors sat beside a conveyor belt, and as the lamp bases passed by, they picked up each base to inspect both sides for possible flaws. With the new machine, the brass-plated iron bases are carried by a conveyor belt to the end of a sloping metal table, where they are dumped. Each base rolls into one of eighteen parallel grooves extending half the length of the table. The vibrating motion and downward slope of the table causes the bases to move along while



Flame-cutting Railway Locomotive Side Frames from Steel Plate at the Lukens Steel Co., Coatesville, Pa.

Display Board in the Syracuse Works of the General Electric Co. which Calls the Attention of Employes to the Time and Money Lost in Broken Tools. Under Each Broken Tool is a Label Showing the Cost of Replacement

the operators inspect the top sides. Then each base enters into a short tube consisting of several pieces of steel in spiral shape. The spiral turns the bases upside down, so that the inspector can see the other side without picking up any but defective bases. At the lower end of the table, the bases fall off into barrels and are packed for shipment.

Plastic Screens Said to be Stronger than Those Made from Metal

A plastic known by the trade name "Saran," which is made by the Acadia Synthetic Products Division of the Western Felt Works, 4029 Ogden Ave., Chicago, Ill., has been widely used by the armed services as a screen material to protect soldiers from disease-carrying tropical insects. The tensile strength of this plastic in wire form, according to *Modern Plastics*, is as high as 50,000 pounds per square inch. When securely framed, the screens made from it are said to be considerably stronger than metal screens. Furthermore, this plastic resists corrosion, dampness, mildew, and tropical heat, and retains great strength at temperatures as low as 30 degrees F. below zero.

Sub-Zero Temperatures Facilitate Ford Assembly Operation

A combination refrigerating machine and dispenser used by the Ford Motor Co. has cut in half the time necessary for a single assembly operation in which parts are assembled through shrinkage by the liquid oxygen method. Tappet guide inserts, thirty-six of which are used on each of the Pratt & Whitney engines made by the company, are shrunk by reducing their temperature to 300 degrees F. below zero in this refrigerating machine.

Outwardly, the machine in which this is done resembles a soft drink vending machine. There are eight openings to accommodate various sizes of guides. To shrink a part, the operator inserts one from stock and presses a solenoid button. Simultaneously, a chilled part will drop into a rubber receptacle; if desired, a chilled part may be obtained without inserting a new one.

The parts never come in direct contact with the liquid oxygen. They are chilled by passing slowly through tubes suspended in a tank of liquid oxygen. The machine used was built to Ford specifications by The Linde Air Products Company.

New High-Speed Electro-Tinning Process for Wire

Copper wire which is to be insulated with natural or synthetic rubber must be coated with tin for protection before the application of the insulation. Heretofore, when tin has been used for this purpose, it has been applied in the molten form by the so-called "hot-dip" process. This method, however, picks up more tin than is necessary, and the heat forms a copper-tin alloy on the wire which has the disadvantage of increasing its electrical resistance and reducing its elongation properties.

A new high-speed electro-tinning process for coating copper wire has been developed by E. I. du Pont de Nemours & Co., Wilmington, Del. This method requires only one-half as much tin as older methods. This electrolytic process deposits the tin without producing an alloy, and therefore does not affect the resistance or elongation properties of the copper wire. Unlike the molten bath employed in the "hot-dip" process, which must be periodically purified, the electrolytic bath does not become contaminated with copper.

Editorial Comment

In time of peace, every nation produces more than it consumes. That is why each generation is able to leave to the next a heritage of homes, factories, transportation systems, irrigation projects, and other achievements. These things represent the excess of production over consumption.

In times of war, we consume or destroy more than we produce. In addition to used up munitions and war equipment, the work of generations in the form of cities, buildings, and communication systems may be destroyed in a few minutes; hence, when peace comes, there is a tremendous need for restoring and replacing that which has been destroyed and lost. Besides, pent-up civilian needs must be met.

Real Post-War Job is to Produce More than We Consume

One of the most important post-war problems, therefore, is to produce more than we consume. If that is not done, we will not be able to replace that which has been destroyed, and our generation will leave nothing behind it to augment the heritage of the nation, or of the human race as a whole. When everything that is produced is consumed, as in time of war, there is nothing left for expanding the facilities of production; but it is by such expansion that the welfare and comfort of the people are provided for.

In wartime, when the Government requires everything that the individual earns or produces beyond a bare living, there is nothing left for industrial investment—that is, nothing left for providing additional facilities for production. In fact, there is often nothing left for maintaining the facilities in their pre-war shape.

Individual Enterprise Must be Free to Create Jobs

In post-war years, therefore, in order that we may produce more than we consume, individual enterprise must be given reasonable freedom to operate, and management must be permitted to accumulate sufficient reserves to maintain employment and keep industry in a healthy state. Every law, every regulation, and every effort on the part of Government, and every endeavor of the management of industrial enterprises and of labor should be predicated on the proposition that we must produce more than we consume. If we do not, we are headed for economic destruction; and that, in turn, means the destruction of all other values of civilization, for the maintenance of which we are now paying such a high price in lives, suffering, and materials.

One phase of the subject of full employment after the war has been almost completely, and sometimes intentionally, overlooked. The wage rate has a great deal to do with employment. During the war, the Government has been in a position to spend the taxpayer's money freely and wages in the war industries have reached figures never before attained in peacetime. The Government does not have to sell what it produces; but when goods have to be sold to the general public, wages cannot for long be higher than what the public considers the services rendered are worth. Labor can over-reach itself by asking so much for its services that the public will not buy the goods produced because they are priced at too high a figure.

Wages Must be in Proportion to Services Rendered

It is in the interest of industry to pay the very highest wages possible commensurate with the price of the product, because high wages spell high purchasing power; but when the point is reached that compensation for services is greater than the services are worth in the market place, then the demand for goods falls off, manufacturers must reduce their working forces, and unemployment is the result.

There is a well defined balance that cannot be artificially manipulated. High wages make for purchasing power and a high standard of living, but too high wages cause diminishing demand and unemployment. As an example may be mentioned the building trades previous to the war. The unions in that field had managed to attain wage levels higher than those paid in almost any other occupation, with the result that a large percentage of the members of those unions were idle because building costs became prohibitive—especially home-building costs.

There is grave danger that a serious mistake in this direction will be made when peace returns. The effects may not be immediate, but in time, are certain to be felt.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Cam Designed to Provide Longer Stroke without Enlarging Operating Space

By L. KASPER

The cam shown at *B* in the accompanying illustrations serves to impart a reciprocating motion to the machine slide *G*. The slide is required to have a longer stroke than could be produced by a cam of conventional design and of a size which could be assembled in the recess *W*. This unusual and interesting design of the cam was therefore necessary to provide the long stroke required without increasing the diameter of the cam.

Plan views of the mechanism are shown in Figs. 1 and 3, Fig. 2 being an end view. The complete assembly is shown by Figs. 2 and 3, whereas Fig. 1 shows the mechanism with the slide *G* removed. This view, however, shows the cam follower rollers *C*, *D*, *E*, and *F* in the respective positions they occupy when assembled on the under side of slide *G*.

Referring to Fig. 1, the shaft *A*, to which cam *B* is keyed, rotates in the direction indicated by the arrow. Cam *B* is provided with a series of projecting surfaces or cam tracks indicated by reference letters *H* to *N*, inclusive. The four roller followers *C*, *D*, *E*, and *F*, assembled on the under side of slide *G*, are equally spaced on the center line.

Rollers *C* and *D*, Fig. 1, act as cam followers on opposite sides of the track *H*. Rotation of cam *B* in the direction indicated causes these rollers to move toward the periphery of cam *B* at a rate of speed governed by the shape of track *H*. As roller *C* reaches the periphery of cam *B*, roller *D* reaches the position previously occupied by roller *C*, Fig. 1, since the center distance between rollers *C* and *D* is equal to the rise of cam track *H*.

When roller *C* reaches the periphery of cam *B* it ceases to function as a cam follower, but the motion of the slide *G* is continued by rollers *D* and *E*, acting as followers on track *I*, which at this point is in the position previously occupied by track *H*, as shown in Fig. 1. Track *I* then functions as a cam between rollers *D* and *E* until track *J* reaches the same position, when rollers *E* and *F* act as followers to continue the movement of slide *G*.

In Fig. 3, the rollers *E* and *F* are shown at the highest point to which they are carried by

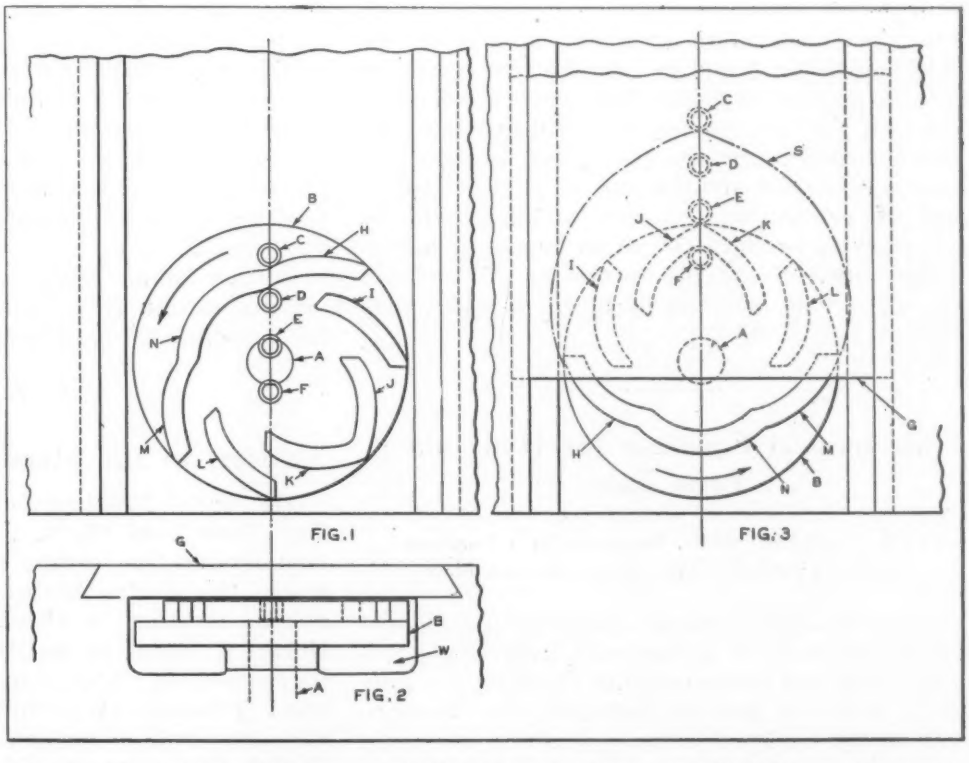
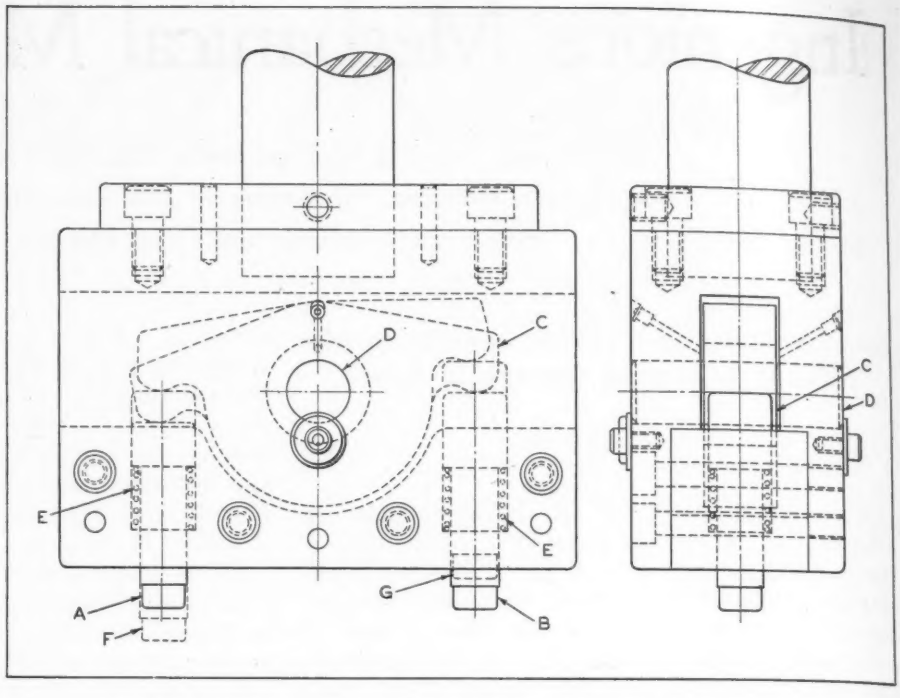


Fig. 1. View of Cam for Operating Slide G, Fig. 3, Shown with Slide Removed but with Slide Follower Rolls in Positions They Occupy when Slide is at Lowest Point of Travel. Fig. 2. End View of Cam B and Slide G. Fig. 3. Plan View of Assembled Cam B and Slide G, with Latter Member at Highest Point of Travel

the track *J*, slide *G* having reached the extreme end of its upward travel. As cam *B* continues rotation, tracks *K*, *L*, and *M* pass in succession between rollers *F*, *E*, *D*, and *C*, returning the slide *G* to its original position. As track *N* is concentric with the center of rotation of cam *B*, the rollers *E* and *F* and slide *G* remain stationary until track *H* is again brought into position, as shown in Fig. 1, to complete the operating cycle.

In the design illustrated, the upward stroke or travel of slide *G* at a uniform speed is produced by cam *B* during 135 degrees of its rotation. The reverse or downward stroke of slide *G* at uniform speed is also produced by cam *B* while rotating through an angle of 135 degrees. Following this complete reciprocating movement, the slide *G* remains stationary at its lowest point of travel while the cam *B* rotates 90 degrees to finish one complete revolution. With this type of cam, an irregular motion of the slide can be produced by varying the shape of the cam tracks, provided that each track is so designed that its leading end will continue the motion produced by the cam which preceded it. In order to compare the size of cam *B* with a cam of conventional design which would be necessary to produce the same length of stroke or movement of slide *G*, an outline of the track for such a cam is indicated by the dot and dash lines at *S*, Fig. 3.



Device Attached to Ram of Hydraulic Press to Obtain Equalized Application of Pressure by A and B

The pressure is transmitted to two fixtures (not shown) by the pins *A* and *B*, the pressure being equalized by the arm *C* which is pivotally mounted on pin *D*. The pins *A* and *B* are shown by solid lines in their normal operating positions, with springs *E* holding the pins in contact with the equalizer arm *C*.

Assuming that the fixture in contact with pin *B* offers greater resistance to the pressure exerted by the arm than does the fixture in contact with pin *A*, the pin *A* would advance while pin *B* receded, so that they would occupy relative positions such as indicated by the dotted lines at *F* and *G*.

Certain minor changes were made after the original design (illustrated) was developed, but the principle of operation remains the same.

Mechanical Equalizer for Hydraulic Press Ram

By J. G. ALEXANDER, General Plants Engineer
National Fireworks, Inc., West Hanover, Mass.

A mechanical equalizer designed for mounting on the ram of a Greenerd hydraulic press is shown in the accompanying illustration. This device is being used to distribute the pressure exerted by the ram equally between two consolidating fixtures mounted on the press platen. The application of equalized pressure to the two fixtures takes care of any variations in height during the consolidation operation.

* * *

Officers of the Metal Treating Institute

The Metal Treating Institute, 420 Lexington Ave., New York 17, N. Y., which includes in its membership the leading commercial heat-treaters in the United States, at its recent twelfth annual meeting in Cleveland, Ohio, re-elected Horace C. Knerr of the Metlab Co., Philadelphia, Pa., president. L. A. Lindberg, of the Lindberg Steel Treating Co., Chicago, Ill., was elected vice-president. Franklin T. Chapman of the Metlab Co., was reappointed treasurer of the Institute, and Stewart N. Clarkson was reappointed executive secretary, with offices at the headquarters of the Institute.

Progress in Automatic Arc Welding

Improved Automatic Arc-Welding Machines and Equipment are Capable of Reducing Costs, Increasing Production, and Improving Quality of Product — Second of Two Installments

By R. F. WYER
Application Engineer, Electric Welding Division
General Electric Co., Schenectady, N. Y.

THE first installment of this article, published in November MACHINERY, dealt with types of automatic welding handled on arc-welding machines, the design and operation of different types of machines, factors to be considered in efficient automatic arc welding and in the design of welding fixtures, and the use of chilling bars. The present and concluding installment will deal with the use of bars and gas for backing in machine arc welding, magnetic control of the arc blow, and the positioning of the electrode and the work.

The function of backing in machine arc welding is extremely important. In many respects it is the same as that of chilling, since the backing means does not usually come in contact with the molten under surface of the pool of metal. Such contact usually results in too rapid chilling of the pool, with consequent entrapment of gas, which produces porosity in the weld. There are exceptions to this rule, notably in the case of welding aluminum with the atomic-hydrogen arc or the inert-gas shielded arc, where it is practical to permit the molten aluminum to sag down and be mechanically supported by the backing. The contour of the under surface of the bead may be thus controlled by the shape of the groove in the backing member.

Another exception to this rule will probably become apparent in the next few years with the advent of ceramic backing materials, which can be molded or otherwise shaped to suit the contour and desired appearance of the back of the weld. Much work along this line has been done in the last year or two, and it is quite likely that its results will be evidenced in production welding practice as details of the method become available to the public.

As in the case of top chill, the use of backing bars for chilling and clamping is usually confined to relatively thin stock. Heavy sections generally do not need clamping, and, in fact, are not amenable to clamping without excessively heavy and expensive fixtures. Backing bars, as distinguished from backer strips, which are fused into the bottom of the joint and must be chipped off, are employed, as a rule, only in welding sections thinner than 1/4 inch. For light work, however, such, for example, as range

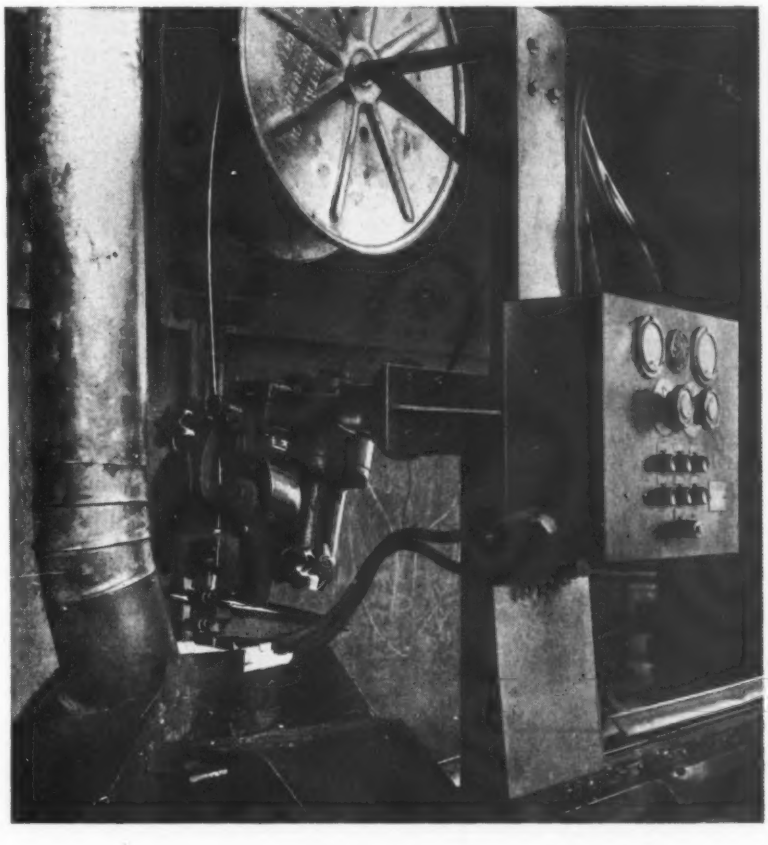


Fig. 8. Thyratron-controlled Automatic Arc-welding Equipment Producing an Arc-welded Seam at the Rate of 48 Inches per Minute, 24 Hours a Day, in Making Square Tubing

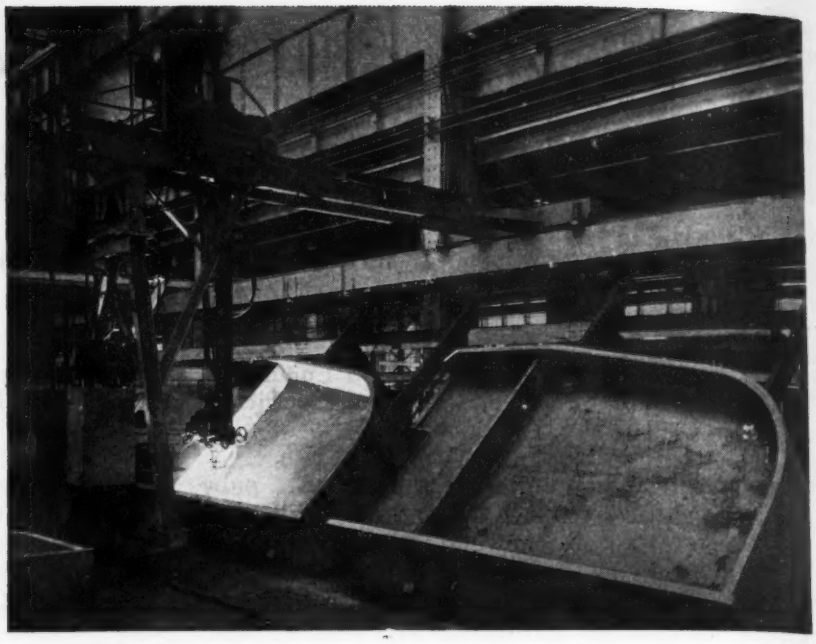


Fig. 9. General Electric Gantry Type Machine Arc Welder with a Capacity for Work 40 Feet in Length, 18 Feet in Width, and 11 Feet in Height

boilers of 10 and 14 gage, backing bars are very widely employed.

In this connection, it should be remembered that the manual welder can do something that the machine welder cannot do. The welding operator can compensate for a tendency to drop through, by a change in arc length, angle of the electrodes, or travel speed. This is not practical in machine welding with automatic heads, and therefore bottom chilling or backing bars are employed to compensate for this factor as far as possible. They may be effective either by actually supporting the metal mechanically at a very few places where drop through would otherwise occur or by chilling the material as it becomes excessively hot in one spot prior to a drop through.

It is apparent that if plate thickness, fit-up, preparation, electrode characteristics, travel speed, and arc length were absolutely uniform throughout the length of the joint, it should be possible to obtain uniform penetration to the root of a butt joint without danger of burning a hole in the work. Since one or more of these factors usually has some variation in actual welding practice, the bottom chill or backing bar is used frequently to compensate for these variations where the mass of the work is not sufficient to do so automatically.

In atomic-hydrogen arc welding, the use of a hydrogen gas backing is often advantageous. It can be employed in places where mechanical backers or chills could not be applied, and it has the advantage of simplicity and of keeping the back of the weld clean. A small amount of hydrogen is applied to the back of the weld, either in the form of a jet of burning gas or as a layer which rises to the under side of the weld in the case of partially closed containers. The hydrogen, being a very effective coolant, chills the molten metal uniformly. It has still another advantage. Since the surface tension of an oxide-free film of molten metal is higher than that of one contaminated with oxide, the hy-

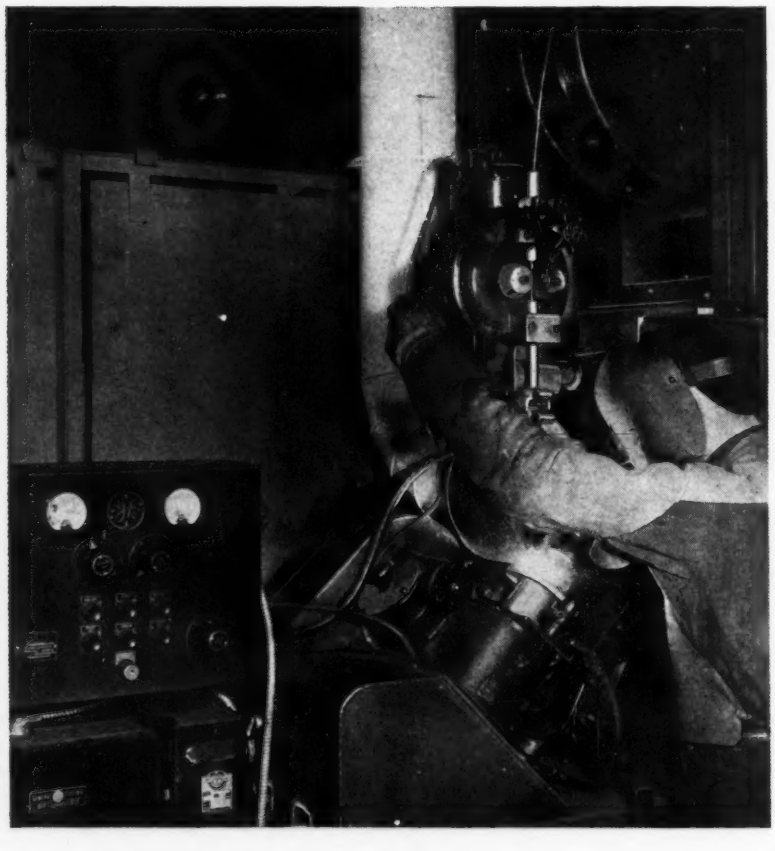


Fig. 10. Producing Small Fillet Welds with 3/32-inch Lightly Coated Electrodes at the Rate of 14 Inches per Minute, on a Pressed-steel Cable Coupler Shell

drogen, by excluding oxygen, increases the surface tension of the under side of the pool. This helps to support it, not by the pressure of the hydrogen gas, but simply by the surface tension of the metal itself.

In direct-current machine welding, the control of magnetic arc blow is frequently very important. This is another place where the manual welding operator can do something that the automatic welding head cannot do. In manual welding, the operator can change his technique, particularly the angle of the electrode with respect to the work, to suit variations in the blowing, or distortion, of the arc by the magnetic fields set up in and around the welding zone. But in machine welding two other methods of arc blow control can be used to minimize magnetic disturbances.

One is the use of insulating parts in the fixture, sometimes with a return-current contact brush riding on the work, to fix the path of the return current with respect to the arc location and thus to eliminate a troublesome variable. The other method is the use of coils to produce magnetic fields which will compensate for the effect of the normal field and thus stabilize the position of the arc. Such compensating fields can be adjusted both in magnitude and in direction to suit the needs of the job being handled.

Particularly where experience with similar machine welding applications or tests with manual welding indicate that magnetic arc blow is likely to be a problem, these control or compensating measures should be carefully considered by the fixture designer.

Provision for the proper adjustment of the position of the electrode is also an important consideration in fixture design. A machine welding fixture may be mechanically perfect and the automatic welding head functioning correctly, and yet produce poor welds if this factor is neglected. This applies to the angle of the electrode with respect to the plane of the joint in straight seams or circular seams about a vertical axis. In the case of circular seams in a vertical plane (axis horizontal), the position of the arc with respect to the vertical line through the axis is important in controlling whether welding is done "up hill" or "down hill" or not, and the angle between electrode and seam. See Fig. 11.

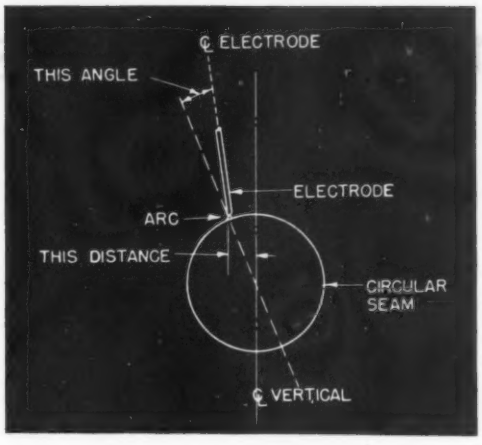


Fig. 11. Angle of Electrode and Distance of Arc from Top Center of Work, as Indicated in Diagram, Should be Adjustable

Positioning the Work

Closely related to the location of the electrode is the positioning of the work in machine welding. Although fillets can usually be made in the horizontal position if necessary, they should be made in the flat position where feasible. This requires inclining the axis of rotation in circular work. Inclination of the axis of rotation away from the vertical is also often desirable in welding edge and corner joints, as shown in Fig. 12. This allows taking advantage of gravity in controlling metal and slag flow to produce welds of the desired contour at high speeds.

To summarize, the automatic arc welding unit is a money-saving, production-improving device when it is properly applied. Proper application means, primarily, keeping it busy and supplying it with work-pieces which are uniform in design and joint preparation. To get the most out of automatic welding, the whole application should be engineered as a unit, with the design of product and joint, the tolerances on preparation, and the design and construction of the fixture based on the knowledge that automatic welding heads are to be used.

Making the traverse of work or welding head run true and at uniform speed, clamping the work accurately, and placing loading stations and machine adjustment controls convenient to the operator are important factors in obtaining high rates of production and work of uniformly good quality.

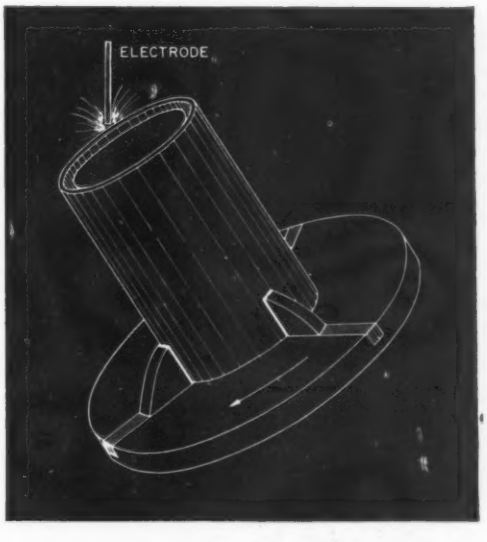


Fig. 12. Welding Down-hill on Circular-edge Type Weld

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Patent Laws Versus Anti-Trust Laws

M. U.—Can the owner of a patent who sells a semi-finished article to a wholesaler for the latter to finish and resell control the price to be charged by the wholesaler if the patent covers both the semi-finished and the finished product?

Answered by Adelbert Schapp, Patent Attorney San Francisco, Calif.

With the Patent Office granting patent monopolies at the rate of forty thousand per year, and with the Sherman Anti-Trust Act declaring contracts in restraint of trade illegal and condemning any attempt "to monopolize any part of the trade or commerce among the several states," it is only natural that frequent clashes should occur between the patent laws and the anti-trust laws. One of the principal points about which clashes hinge is the question of how far a patentee may control prices of the patented article through the various steps that are usually necessary to deliver the article to the ultimate consumer.

Generally the Supreme Court has established two rules: (1) A license agreement under a patent may contain any reasonable restriction, including a price fixing clause. This enables the patentee, for instance, to license the patent to different parties under a common price-control scheme. (2) An actual sale of a patented article ends the patent monopoly, and the seller cannot further control the resale price of the article.

A new angle was brought out in a recent Supreme Court case: Smith owned a series of patents covering multi-focal lenses in blank (semi-finished) and finished forms. He licensed Jones to manufacture the blanks and to sell the same to wholesalers for finishing and reselling, subject to certain price restrictions. This contract, being a mere license, was clearly within the law under the first rule. The wholesaler paid for the blanks and became the owner. Under the second rule he would be entitled to do with them as he pleased. Any attempt to subject the wholesaler to price restrictions would run afoul of the anti-trust laws.

However, an unusual feature was injected into the situation by the fact that the wholesaler, in grinding the blank into a finished lens, created a product which again was controlled by the Smith patent. Acting upon the theory that this situation called for a second license agreement between Smith and the wholesaler, an additional contract was entered into between the two, in which Smith licensed the wholesaler to finish the blanks and subjected the latter to certain price restrictions in the sale of the finished lenses. This again being a license agreement, Smith assumed that he was steering clear of the anti-trust laws.

But the Government thought differently and brought suit in an attempt to have the system of price control declared illegal. The Supreme Court, sustaining the Government, held, in substance, that the first sale of the blanks to the wholesaler necessarily included the right to use the blanks for the intended purpose, that there was no occasion for a special license permitting the wholesaler to finish the blanks, and as a consequence, that there was no justification in the patent laws for the resale price restrictions.

In the words of the Supreme Court: "But in any case it is plain that where the sale of the blank is by the patentee or his licensee to a finisher, the only use to which it could be put and the only object of the sale is to enable the latter to grind and polish it for use as a lens by the prospective wearer. An incident to the purchase of any article, whether patented or unpatented, is the right to use and sell it, and . . . the authorized sale of an article which is capable of use only in practicing the patent is a relinquishment of the patent monopoly with respect to the article sold. Sale of a lens blank by the patentee or by his licensee is thus, in itself, both a complete transfer of ownership of the blank, which is within the protection of the patent law, and a license to practice the final stage of the patent procedure. . . . Hence the patentee cannot control the resale price of patented articles which he has sold, either by resort to an infringement suit or by stipulating the price maintenance by his vendees."

"No one would doubt that if the patentee's licensee had sold the blanks to a wholesaler or finishing retailer. . . . the purchaser would not infringe by grinding and selling them. The added stipulation by the patentee fixing retail prices derives no support from the patent, and must stand on the same footing under the Sherman Act as like stipulations with respect to unpatented articles."

Welding Ni-Resist Castings

A.C.H.—The writer would appreciate information on how best to weld Ni-Resist castings with the metallic arc method.

Answered by Editor, "Nickel Cast Iron News," International Nickel Co., Inc., New York City

Monel 130X electrode is well adapted to this purpose. The procedure to follow is the same as that recommended when welding Monel, with the exception that in the case of Ni-Resist a cast iron is being welded, and the usual possibilities of cracking associated with cast-iron welding are present.

We recommend the following precautions to be taken when arc-welding all cast irons, including Ni-Resist:

1. Prepare the cast iron crack by beveling to no more than a 60-degree included angle. Leave 1/16 inch of cast iron at the bottom of the vee. Butt the two parts to be welded as tightly as possible. Sections greater than 1 inch thick are very likely to crack in the iron next to the weld.

2. Preheat to from 500 to 1000 degrees F.; do not permit the castings to go below the preheating temperature during welding. The highest preheat temperatures give the greatest assurance of crack-free welds.

3. Lay in the weld metal in narrow beads with electrodes of Monel No. 130X, using reversed polarity with 90 to 100 amperes for 1/8-inch, and 120 to 130 amperes for 3/16-inch electrodes. Do not use larger electrodes. A bead of not more than 2 1/2 inches in length should be laid down, followed immediately by peening.

4. Excessive shrinkage stresses are set up (with subsequent cracking) if a wide, heavy bead is laid down in one pass. Narrow string beads are, therefore, recommended.

5. After deposition of the first bead, succeeding beads should be laid alternately, first on one side, then on the other side of the vee, finally joining these beads with a single pass through the center. This will prevent the shrinkage of the weld metal clear across the vee, resulting nearly always in cracking.

6. After welding, the entire casting should be permitted to cool slowly from the preheating temperature.

* * *

An ounce of experimentation is worth a pound of untried theory.—*Charles F. Kettering, Vice-president, General Motors Corporation.*

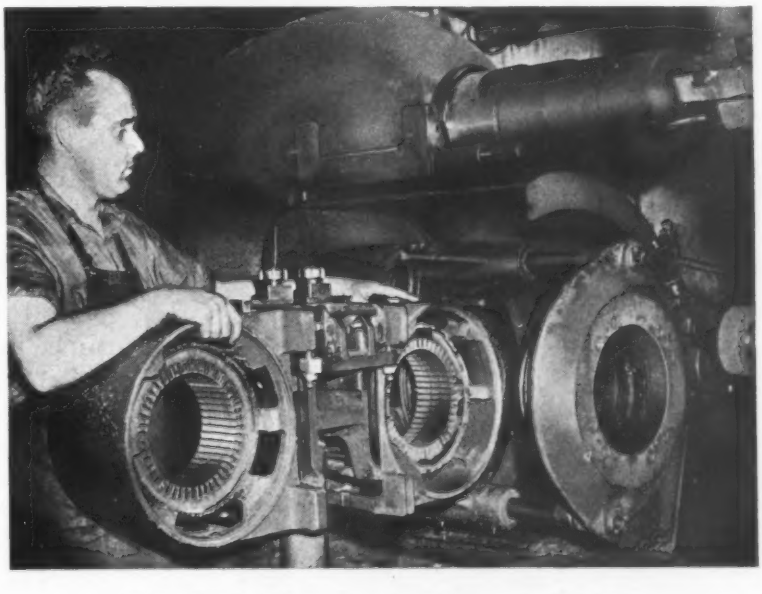
Special Loading and Unloading Fixture for Grinder Simplifies Work-Handling

In the internal grinding of Tri-Clad motor stator cores at the Lynn River Works of the General Electric Co., the special pivot type fixture shown in the accompanying illustration has accomplished a notable reduction in the time and effort required in transferring the cores to and from the grinder. One of the advantages of the fixture is that it can be loaded and unloaded during the grinding cycle.

The illustration shows the operator pivoting the fixture into the loading position. The stator core on the left is completed and the one on the right is being swung in between the machine clamping rings. After the stator core has been secured in the machine, the fixture will be swung back and the grinding operation started. During grinding, the completed stator is removed and replaced by an unground one. The other part of the fixture remains empty, so that it can be used for unloading the stator being ground.

* * *

According to Stevenson, Jordan & Harrison, Inc., management engineers, the average hourly earnings in manufacturing rose from 16.5 cents in 1901 to $1.01 in April, 1944. That means that hourly wages are, on an average, more than six times as great at the present time as forty-three years ago. In the same period, the cost of living has risen so that it takes today $2.24 to buy what could be bought for $1 in 1901. In other words, hourly wages, expressed in dollars and cents, have increased six times, while the things bought with the wages have increased less than two and one-half times over this period of years.



Using Special Fixture to Load Stator in Machine for Bore-grinding Operation

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Micarta 444, A Hot-Forming Laminated Plastic

A new development in the field of laminated plastics, known as Micarta 444, has recently been announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This material, when heated rapidly to a temperature of about 275 degrees F., passes through a stage of considerable flexibility. Upon cooling to ordinary temperatures, it recovers its average physical properties.

This new laminated plastic has a tensile strength of 13,000 pounds per square inch, a flexural strength of 19,000 pounds per square inch, and a compressive strength of 30,000 pounds per square inch. Unlike most thermoplastics, it does not become brittle at temperatures below zero, but maintains 85 per cent of its impact strength and gains 25 per cent in ultimate tensile strength at minus 4 degrees F. It does not wilt at elevated temperatures, but maintains 60 per cent of its tensile strength and gains 50 per cent in impact strength at 170 degrees F.

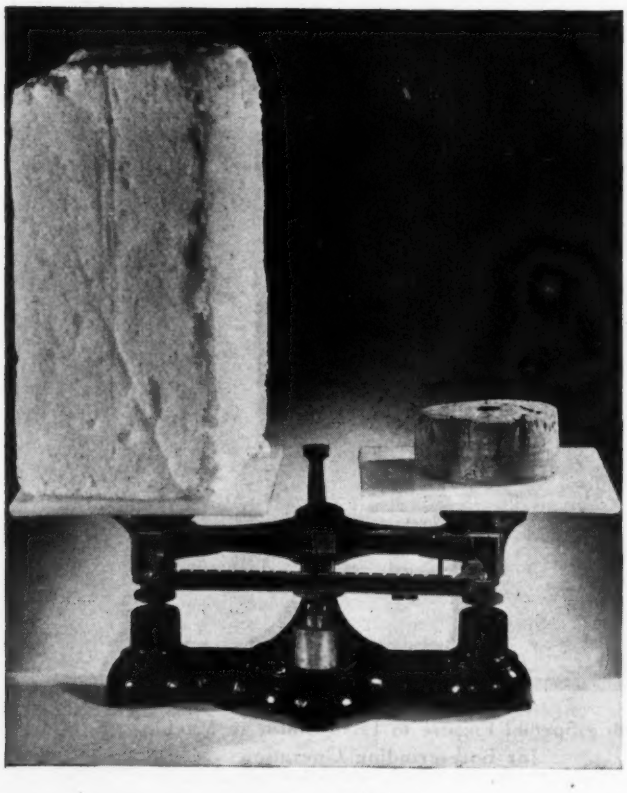
Drawing and shaping of the new plastic without a draw-ring is possible. A mold for this type of work may be set for a draw of 10 per cent in either grain direction of the material and as much as 40 per cent on the diagonal. The inside radius of a bend may be as little as 1/32 inch for a 1/32-inch thickness or 3/32 inch for a 1/16-inch thickness. Both the appearance and good structural characteristics of this material give promise of many applications. 201

Synthetic Rubber Compound Used for Tight Seals

A Thiokol synthetic rubber sealing compound of the Latex type known as "Galco," which is designed for spray, brush, or slush application, is now being manufactured by the Presstite Engineering Co., 3900 Chouteau Ave., St. Louis, Mo. This compound was developed especially for sealing airplane integral fuel tanks. However, its characteristics, which include low diffusion rate, low solubility in aromatic fuel and water, and high adhesion to aluminum, steel, wood, and other materials, make it suitable for many other uses. It will maintain a tight seal over a wide temperature range. 202

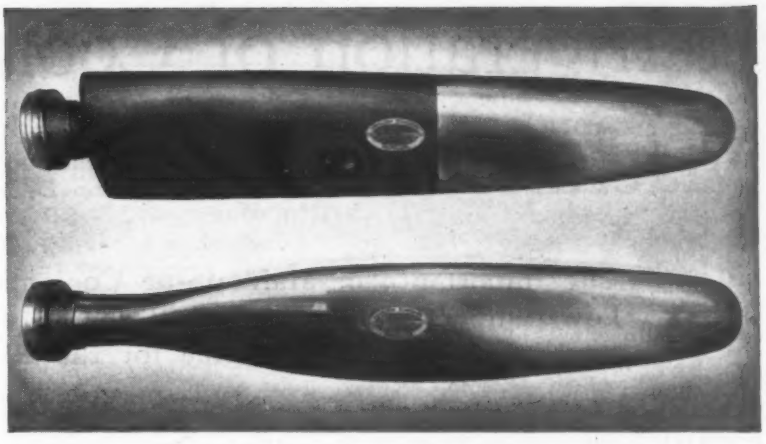
High Heat-Resisting Paint for Interior and Exterior Use

A high heat-resisting paint, designated Triple-A, has been developed by the Quigley Co., Inc., 527 Fifth Ave., New York 17, N. Y. This paint can be used on interior or exterior surfaces subjected to high temperatures. Under normal



Plastic Foam Weighing Only One-seventh as Much as Cork has been Developed and is being Manufactured for Important War Uses by the United States Rubber Co. Many Important Peacetime Uses are Foreseen, Including Insulation for Trains, Airplanes, Automobiles, and Homes

To obtain additional information on materials described on this page, see lower part of page 204.



(Top) A Hamilton-Standard Propeller Fitted with a Synthetic Rubber Propeller Fairing which Increases Flow of Cooling Air through Engine. (Bottom) A Propeller before Addition of Fairing

interior conditions, it is ready for service after air drying.

For extremely wet interiors, or for exterior use, it is conditioned after application by heating to 300 to 500 degrees F. When so heat-treated it will resist water, oil, gasoline, benzol, heat, and weather. On light steel it will adhere under rapid heating and cooling when subjected to temperatures up to 1400 degrees F. On alloy steel, brick, etc., it will withstand temperatures up to 2500 degrees F. This paint is non-inflammable and does not give off fumes or odors when heated. 203

Rubber Coating Glass Cloth Solves Aircraft Equipment Problem

A flame-proof, synthetic-rubber coated glass cloth developed to solve several major problems in combat plane equipment design is announced by the United States Rubber Co., Rockefeller Center, New York City. Great tensile strength at abnormally high temperatures, extreme lightness in weight, and high tear resistance are its main features. In addition, it is fireproof, gasoline-proof, oilproof, grease-proof, waterproof, mildew- and insect-proof, and is not affected by either acids or alkalies.

One important use at the present time is to protect personnel in Superfortresses and Flying Fortresses at high altitudes through the elimination of possible breaks in metallic heating ducts caused by vibration and other contributing factors. By sealing joints in hot air ducts, this material gives the heater system of the plane greater efficiency.

The new material is made in a range of gages from 0.006 to 0.040 inch thick and in tensile strengths from 165 to 800 pounds per inch of width. Aviation companies that are employing this material at present in aircraft building are also testing it for many other war uses. It is believed that it will have many important post-war uses as well. 204

Propeller Fairing Material Now Available for Industrial Use

Cell-Tite, an ebony-like cellular rubber material with a high strength-weight ratio and considerable hardness, has been effectively utilized for fairings on Hamilton-Standard propellers. This material, which is now being made available for industrial use, is manufactured by the Sponge Rubber Products Co., 182 Housatonic Ave., Derby, Conn.

Cell-Tite is said to have more buoyancy and lower water absorption than cork, a high resistance to chemical attack, and good aging properties. It has also good thermal, electrical, and sound insulation qualities. It can be sawed, drilled, planed, and otherwise worked, much the same as wood. 205

New Advance in Field of Plastic Preforming

An outstanding advance in the field of plastic preforming has recently been announced by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This process has resulted in the production of a plastic that has a high degree of strength and formability.

In its early stages this plastic is a soup-like mixture of wood pulp, water, and a phenolic resin which resembles a thick maple syrup. Fine copper gauze, having 3600 holes per square inch, is fashioned into the form of the finished product and the plastic mixture is sucked onto it. The water in the mixture passes through the openings of the gauze leaving the fibers, which have been individually coated or impregnated with the resin, on the wire gauze.

After being stripped from the form and dried in a warm oven, the preformed piece is placed in a heated mold and pressed to final shape. In this final molding, the amount of pressure can be varied to produce plastics having different densities. 206

To obtain additional information on materials described on this page, see lower part of page 204.

Refrigeration of Coolants for Machine Tools

By B. S. WILLIAMS
Industrial Research Department
Airtemp Division, Chrysler Corporation

The Importance of Maintaining Coolants and Cutting Oils at a Low Temperature has Recently Become More and More Recognized. Equipment is Now Available for the Refrigeration of Coolants

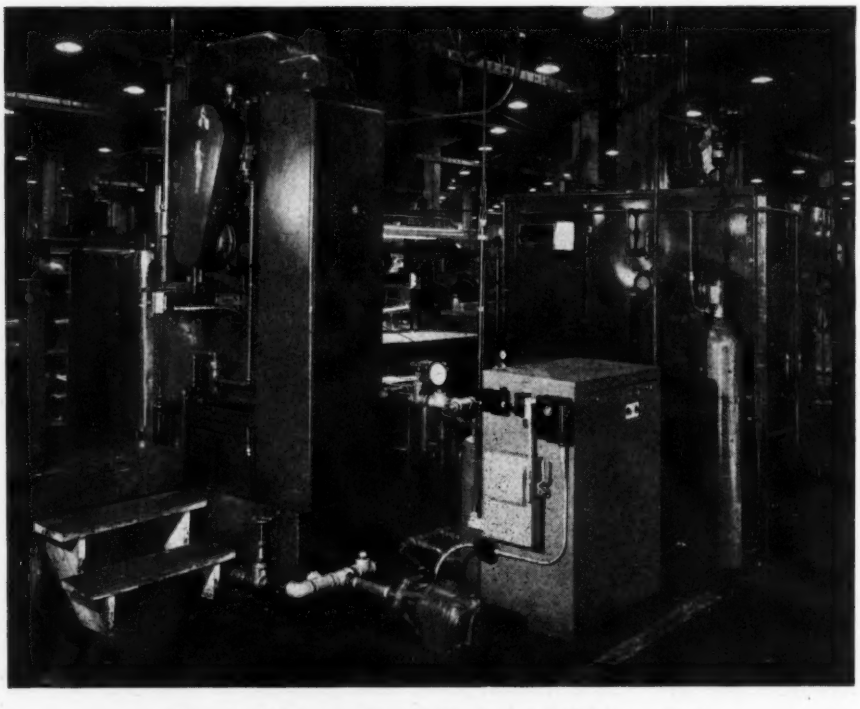
THE high temperatures at the cutting edge of a tool produced by high cutting speeds may cause a welding action between the chip and the tool, as well as a softening of the tool edge, resulting in poor finish, excessive tool wear, and loss of production. To reduce these high temperatures, refrigeration of the coolant or cutting oil has been successfully employed.

The need for application of mechanical refrigeration to the coolant used on machine tools was first brought to the attention of the Chrysler Airtemp Division about two years ago by an aircraft manufacturer. His problem was to increase the speed of production of landing-gear cylinders drilled out of solid steel stock. The tool used was a hollow drill, taking a cut 4 1/2 inches in diameter by 26 inches deep.

The coolant flowing over the drill, being used over and over again, gradually increased in temperature until it reached 157 degrees F. At about this point, the drills burned and frequent tool changes were necessary. Much time was spent in stopping the machine, making adjustments, and changing the tools. The burning and breaking of the tools also created an excessive tool cost.

The problem was solved by cooling the cutting oil flowing over the work to approximately 70 degrees F. After this had been done, the cutting time per cylinder was reduced from 1 hour and 50 minutes to 1 hour. Damage to the drills was materially reduced and less machine time was lost.

Based on this and similar experiences, the conclusion has been reached that the coolant which flows over the work in a machine tool should be maintained at a constant temperature the year around, irrespective of the room temperature. This temperature should be sufficiently low to promote effective cooling of the work. Usually it is not necessary to go below 70 degrees F. to obtain the desired results.



Chrysler Airtemp Liquid Cooler Applied to a Baker Drilling Machine for Cooling the Cutting Lubricant, thereby Increasing Production 25 Per Cent

Many advantages are gained by maintaining the coolant at a constant temperature, among which are the following:

1. *Longer Tool Life*—Excessive temperatures of the cutting oil or compound cause cutting tools to soften and wear rapidly. High temperatures at the point of cutting often build up metal that welds to the face of the tool. This causes frequent changing and grinding. Application of refrigeration to the cooling system on machine tools has sharply reduced the tool replacement cost and also the time lost in changing tools.

2. *Less Machine Adjustment*—Changes in dimensions caused by changes in cutting oil temperature must be compensated for by frequent adjustment of the machines. Machine tools must also be adjusted to compensate for tool wear, and this takes considerable time. The delay causes loss in time of machine and operator.

3. *Closer Tolerances*—Rising coolant temperatures cause changes in the machine set-up, making it difficult to hold accurate dimensions of work. Units machined at one temperature have a different size from work finished at another temperature. Many rejections may follow.

4. *Cooler Work-pieces*—When machined work is too hot to handle, as is often the case when coolant temperatures become too high, the pieces cannot go on to the next operation immediately. This causes a delay in production.

5. *Control of Run-outs*—When there is excessive heat at the point of cut, drills tend to change direction and run out of alignment, making it necessary to back up frequently so that the work can cool. Control of cutting oil temperatures makes it possible to operate the drill faster without delays due to run-outs.

6. *Uniform Oil Viscosity*—Cooling will hold cutting oils at the desired temperature and, therefore, at a constant viscosity. This is highly desirable, because when oil rises in temperature its viscosity changes until the oil becomes so thin that proper lubrication is impossible. When viscosity is greatly reduced, tools burn or break, and imperfections appear in the work surface.

7. *Water Consumption Reduced*—When city water is used to cool a machine tool, it is normally discharged into the sewer. Large quantities are wasted, materially increasing the production cost. Savings in city water consumption often help pay for the refrigeration system.

8. *Increased Production*—With a refrigeration system installed, most machining operation speeds can be increased, thereby increasing production.

Because of the many variables in machine tool operation, it is difficult to obtain an accurate picture of increased production. Test installations show, however, a substantial increase in production where refrigeration of coolant has been applied to machine tools. Obviously, every effort should be made to see that the machine is producing the best results possible, irrespective of the cooling unit. Any further gain may then be credited to the refrigeration of the coolant.

Specific Examples of the Application of Refrigeration of Coolants

A six-spindle automatic chucking machine operating on manganese-steel threaded parts offers a good example of the advantages obtained by the refrigeration of coolants. The coolant is carried to the work through a circular header, from which small pipes lead to all the tools. The coolant is a special oil suitable for general machining and thread cutting.

Before using refrigeration, the temperature of the coolant reaching the work was approximately 98 degrees F. Because of the extreme hardness of manganese steel, many problems were encountered. The tools had to be ground and replaced often, and frequent tool adjustments had to be made. The pieces, when removed from the machine, were too hot to handle, and the fumes created by burning coolant were highly objectionable.

To remedy these conditions, a cooling unit was installed, which maintained the coolant at approximately 70 degrees F. After the refrigeration equipment was operating, the difficulties in machining were either eliminated or greatly reduced. The manufacturer who bought the refrigeration equipment found that the cooling unit was an excellent investment.

Another instance of the use of coolant refrigeration is that of a two-spindle inverted type Baker drilling machine boring 1 3/4- by 18-inch holes in solid steel forged stock of a hardness from 290 to 350 Brinell. Using a sulphur-base cutting oil, the drill would produce only 24 pieces in each nine-hour shift, the breaking of drills and the jamming of chips being the main difficulties. There was evidence of excessive heat at the cutting point. Many times two drills were required to drill one hole. The temperature of the work on the outside increased to 130 degrees F., indicating that intense heat was generated at the point of cutting.

When a cooling unit was installed and the coolant held at 70 degrees F., the production was increased from 48 pieces per day, on the basis of two shifts, to 60 pieces per day, or an increase of 25 per cent over the former production. Great savings were also obtained through reduction in tool changing, tool grinding, and tool replacement. Also, much less coolant was required per day.

A third case may be cited. Here the problem was to increase the production of horizontal deep-hole drilling machines, 30 feet long. The drills used when the machines were first placed in operation had only one cutting edge. With these drills, the time required to finish two pieces simultaneously was four hours.

In an effort to increase the machine capacity, a two-lip cutter was used, and at the same time, the coolant was passed through a filter and returned to the cutting edge. By this means, it was attempted to produce two pieces in 2 hours and 10 minutes. However, the coolant temperatures rose to 140 degrees F., making satisfactory operation of the machine virtually impossible. At the increased oil temperature, the drills had a tendency to run out, and excessive time was lost in changing cutters.

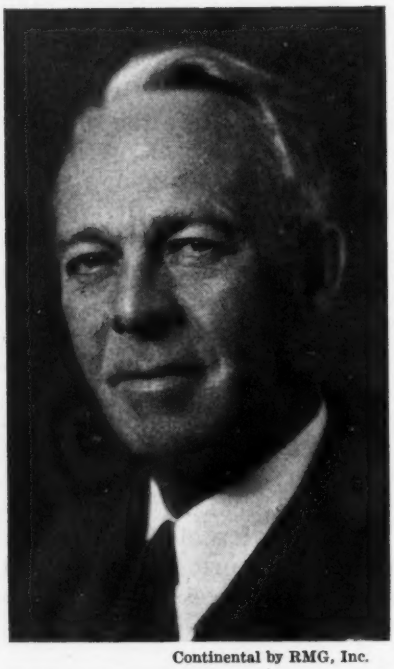
These difficulties were met with in the spring of the year when the highest shop temperatures were about 80 degrees F. The production engineers realized that in the hot summer months the difficulties would be still greater. A cooling unit was therefore installed to maintain the coolant temperature at 100 degrees F. After this cooling system had been placed in operation, it was possible to meet the production rate aimed at—two pieces in 2 hours and 10 minutes—without any difficulties.

It should be noted that the most suitable temperature of the coolant does not depend entirely upon the metal being cut, as the operation is also affected by the cutting speed, the depth of cut, and the condition of the tools, all of which means that some experimentation may be necessary to determine the best coolant temperature.

New Officers of the National Machine Tool Builders' Association

(Left) Joseph L. Trecker, Vice-president, Kearney & Trecker Corporation, New President of the National Machine Tool Builders' Association

(Right) William P. Kirk, Vice-president, Pratt & Whitney Division Niles-Bement-Pond Co., First Vice-president of Machine Tool Builders' Association



(Left) Herbert H. Pease, President, New Britain-Gridley Machine Division, New Britain Machine Co., Second Vice-president of the Association

(Right) Crawford N. Kirkpatrick, President, Landis Machine Co., Recently Elected Treasurer of the Machine Tool Builders' Association

Continental by RMG, Inc.

Accurate Assembly of Threaded Valve Seats and Studs

EXHAUST valve seats are screwed into the forged cylinder heads of the 2200-H.P. radial engines built by the Wright Aeronautical Corporation by the use of Scandia torque machines of the type shown in Fig. 1. Until recently, the exhaust valve seats, like the intake seats, were shrunk into place, but experiments showed that longer seat life, improved valve action, and easier replacements could be obtained by using a screwed-in seat.

However, this introduced production difficulties, since the joint between the valve seat and the cylinder head must be gas-tight, and excessive pressure in inserting the seat may overstress the material surrounding the seat. The first seats were screwed in by hand, but this was not satisfactory from either an engineering or a production point of view, since it was impossible to obtain uniformity. With the Scandia machines, the seats can be driven in with a uniform torque of 7200 inch-pounds. Little effort is required of

Fig. 1. (Above) Exhaust Valve Seats with a Buttress Thread are Screwed into Forged Cylinder Heads of Radial Engines on a Torque Machine which Insures Gas-tight Joints without Danger of Damaging the Threads

Fig. 2. (Left) Another Type of Torque Machine is Used for Driving Studs into Oil-pump Bodies, Crankcases, and Other Parts. Uniformity of Fit is Obtained and Overstressed Metal Avoided

the operator, and there is no danger of fits being too tight or too loose. The seats are made with a buttress thread.

The valve seat is first screwed in by hand to a 100 per cent bearing at the base of the counterbore that it fits, as indicated by the use of Prussian bluing. The cylinder head is then taken to the Scandia torque machine and located over a pin in the holding fixture which fits into the valve guide hole. A yoke prevents the cylinder head from turning. Next the driving spindle is lowered until three keys on the spindle engage slots on the inside of the valve seat. The spindle driving mechanism is now engaged by means of a two-jaw dog, and the seat is driven in until the required torque value is obtained, when the clutch releases and the drive stops.

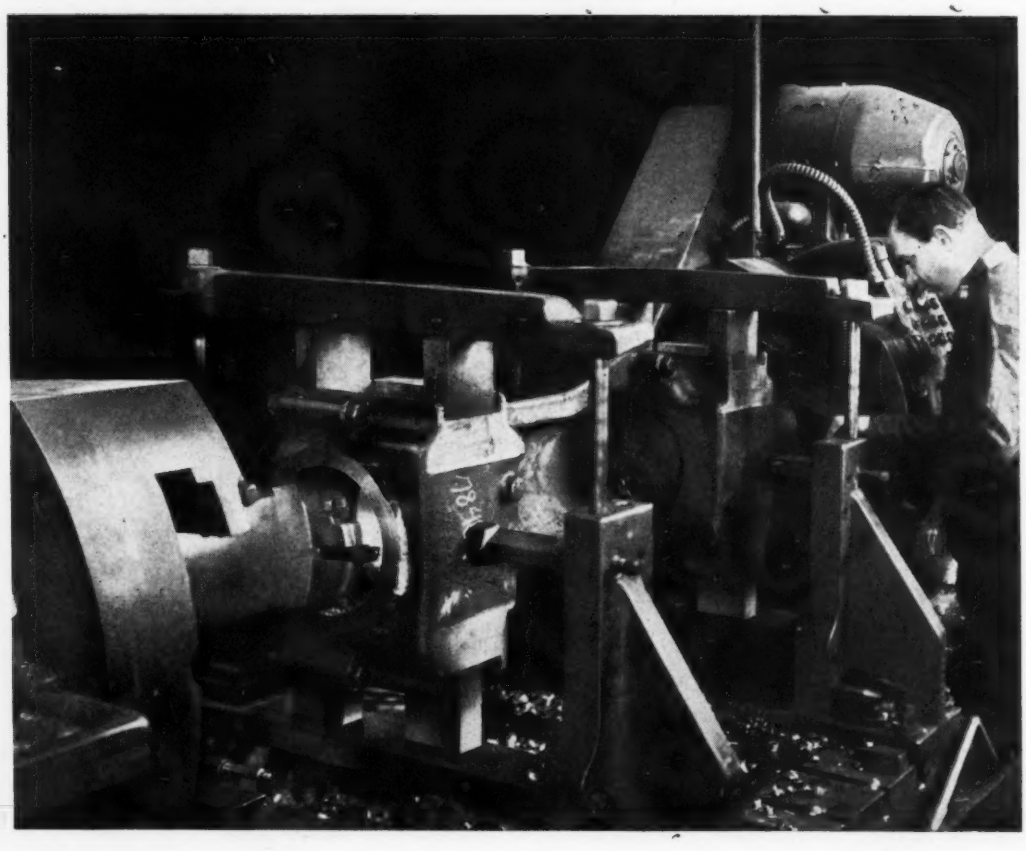
Fig. 2 shows an adaptation of the Scandia torque machine for driving studs into oil-pump bodies. In this case, a snug fit is extremely important, but neither the stud nor the surrounding material must be overstressed. By the use of this machine, torque values can be applied to each stud with such exactness that it is expected in the near future to eliminate detailed inspection of tapped holes and to drive the studs as a line operation immediately after tapping. Under- or over-size studs are automatically rejected.

Boring Locomotive Axle Housings

THE accompanying illustration shows an Ingersoll double-end horizontal boring mill used at the plant of the American Locomotive Co. in Schenectady, N. Y., for simultaneously boring the opposite ends of axle housings of the S K F bearing type. The boring heads are mounted on slides that are adjusted across the faceplates of the two headstocks to enable the tools to be set for cutting to the required diameters. The steel housing casting is held in a fixture to insure close alignment of the bores at the opposite ends.

Each end is bored to three diameters, and the outer ends of the bearing enclosures are faced. Then oil-grooves are machined in the comparatively narrow bore at each end of the bearing enclosures, the cutter being adjusted radially for taking these cuts. When the grooves have been finished, two integral rings or oil slingers remain in these bores of narrow width.

Double-end Boring Mill Employed for Simultaneously Finishing the Bearing Enclosures on the Opposite Ends of Locomotive Axle Housings



New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 203 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the December Number of MACHINERY

Machine Shop for Training Purposes

SIMMONS MACHINE TOOL CORPORATION, 1600 N. Broadway, Albany 1, N. Y. Bulletin describing six basic machine tools for a complete machine shop for vocational training purposes and for small-scale industrial operations; also suitable for Latin-American industrial development and for aiding rehabilitation of war-devastated countries. 1

Resistance Welding

RESISTANCE WELDER MANUFACTURERS ASSOCIATION, 505 Arch St., Philadelphia 6, Pa. Bulletin 101, entitled "Tomorrow's Production Today by Resistance Welding," containing a review of what this process has accomplished in speeding the war effort and its future possibilities for post-war metal fabricators. 2

Temperature Measuring and Other Instruments

LEEDS & NORTHRUP CO., 4934 Stenton Ave., Philadelphia 44, Pa. Folder ENT(7a), covering in detail measuring instruments of various types, including those for temperature, research, teaching, testing, and checking. One of the sections contains information on heat-treating furnaces. 3

Lubrication of Machine Tools

CINCINNATI MILLING MACHINE CO. and CINCINNATI GRINDERS, INC., Cincinnati 9, Ohio. 62-page publication M-1084-2, entitled "Lubrication of Cincinnati Milling, Grinding, Broaching, and Lapping Machines," giving a great amount of lubrication data. 4

Carburizers, Quenching Salts, etc.

E. F. HOUGHTON & CO., 303 W. Lehigh Ave., Philadelphia 33, Pa. Circular containing data on Houghton carburizers, neutral hardening salts, quenching salts and oils, blackening salts, rust preventives, cutting oils, drawing compounds, etc. 5

Cutting Fluids

D. A. STUART OIL CO., LTD., 2739 S. Troy St., Chicago 23, Ill. Booklet entitled "Cutting Fluids for Better Machining," containing information on the selection and use of cutting and grinding fluids so as to obtain the best results on different classes of work. 6

Tool Drivers and Utility Sleeves

J. C. GLENZER CO., 6463 Epworth Blvd., Detroit, Mich. Bulletin on the Utility sleeve tool driver, which cuts small tool costs by functioning as a removable taper shank. Also, bulletin on "Eject or Lock Utility Sleeve." 7

Screw Products

MANUFACTURERS SCREW PRODUCTS, Engineering Department, 222 W. Hubbard St., Chicago 10, Ill., is distributing a handy table of machine screw thread dimensions printed in pocket-size card form. Tap drill sizes and diameters for each screw are also given. 8

Resistance Welding

PROGRESSIVE WELDER CO., 3050 E. Outer Drive, Detroit 12, Mich. Bulletin WP-44 (60-page, 11-inch by 8 1/2-inch book) containing a great many illustrated examples of resistance welding applications, including portable gun welding, stationary spot welding, seam welding, and special uses. 9

Metal-Cutting Tools

PUTNAM TOOL CO., 2981 Charlevoix Ave., Detroit 7, Mich. Catalogue 44, containing 92 pages of data covering the full line of Putnam end mills, chucking reamers, continuous pilot counterbores, holders, and other tools. Engineering data is included. 10

Turret Lathes and Peacetime Production

WARNER & SWASEY CO., Cleveland 3, Ohio. Circular entitled "Now is the Time to Plan Ahead," outlining ways in which the company can help concerns plan for peacetime production. 11

Dial Indicators and Comparators

B. C. AMES CO., Waltham, Mass. 56-page catalogue covering Ames measuring instruments, including dial indicators, micrometers, comparators, cylinder gages, and thickness measuring gages. 12

Small Tool Safety

GEORGE S. MAY BUSINESS FOUNDATION, 111 S. Dearborn St., Chicago 3, Ill. Report No. 155, entitled "Production Weapons—Small Tools Safety," containing suggestions for the conservation and safe use of machine and hand tools. 13

Surface-Treated Sheet Steel

AMERICAN ROLLING MILL CO., Middletown, Ohio. Bulletin on Armco cold-rolled "Paintgrip," describing design and fabricating ad-

vantages of a special surface-treated sheet steel that takes and preserves paint. 14

Twist Drills

REPUBLIC DRILL & TOOL CO., 322 S. Green St., Chicago 7, Ill. Comprehensive catalogue — No. 3-D — covering the full line of Republic twist drills, sleeves, sockets, and drivers. 15

Spiral-Bevel Speed Reducers

PHILADELPHIA GEAR WORKS, INC., Erie Ave. and G St., Philadelphia 34, Pa. Bulletin 200, containing engineering and catalogue data covering the Philadelphia line of spiral-bevel speed reducers. 16

Plastic Coatings

AMERCOAT DIVISION, AMERICAN PIPE AND CONSTRUCTION CO., P. O. Box 3428, Terminal Annex, Los Angeles 54, Calif. Bulletin containing data on "Amercoat" No. 23 plastic coating. 17

Testing Equipment

WILSON MECHANICAL INSTRUMENT CO., INC., 383 Concord Ave., New York 54, N. Y. Bulletin TK-45, on "Tukon" hardness tester; bulletin E-44, on "Equitron" fixture for use with Rockwell hardness testers. 18

Crucible Melters' Handbook

CRUCIBLE MANUFACTURERS' ASSOCIATION, 90 West St., New York 6, N. Y. Crucible Melters' Handbook, covering crucible furnaces and the storing, handling, and use of crucibles. 19

Precision Tapping Chucks and Expanding Mandrels

ERICKSON STEEL CO., 2309 Hamilton Ave., Cleveland 14, Ohio. Bulletin F-1, on precision tapping chucks; bulletin F-2, on expanding mandrels. 20

Finishing Metal Parts

STURGIS PRODUCTS CO., 300 Jacobs St., Sturgis, Mich. Folder entitled "Slash Time and Cost with Roto-Finish for Grinding, Deburring, Polishing, Honing, and Coloring." 21

"Torq-Stop" Wrenches

RICHMONT, INC., P. O. Box 6450, Metropolitan Station, Los Angeles 55, Calif. Bulletin on "Torq-Stop" wrenches and other tools. 22

Die-Heads and Chasers

MURCHEY MACHINE & TOOL CO., Detroit 26, Mich. Reference manual on threading equipment, including die-heads and chasers, together with much tabulated data on various types of threads, tolerances, etc. 23

Tachometers

REEVES PULLEY CO., Columbus, Ind. Bulletin G-448, illustrating and describing mechanical and electrical tachometers for Reeves variable-speed drives. 24

High-Speed Milling Machines

GEORGE GORTON MACHINE CO., 1311 Racine St., Racine, Wis. Bulletin 1400-C, descriptive of five models of Gorton adjustable-ram knee type Super-Speed milling machines. 25

Welder Controls

GENERAL ELECTRIC CO., Schenectady 5, N. Y. Bulletin GEA-4220, containing information on GE seam-welder controls for resistance welding machines. 26

Corrosion-Resistant Tank Linings

UDYLITE CORPORATION, 1651 E. Grand Blvd., Detroit 11, Mich. Circular descriptive of Koroseal corrosion-resistant tank linings. 27

Gears

FAIRFIELD MFG. CO., 309 S. Earl Ave., Lafayette, Ind. Catalogue describing and illustrating twenty-seven different gears and gear sets regularly made by this company. 28

Industrial Ladders

DUO-SAFETY LADDER CORPORATION, Oshkosh, Wis. Circular entitled "Safer Overhead Working on Aluminum," descriptive of a new channel construction ladder. 29

Injection Molding Machines

LESTER - PHOENIX, INC., 2711 Church Avenue, Cleveland, Ohio. Booklet entitled "Shaping the Things of Tomorrow," descriptive of Lester injection molding machines. 30

Combination Jigs

MONARCH GOVERNOR CO., 1832 W. Bethune Ave., Detroit 6, Mich. Bulletin illustrating and describing the "Jiffy Jig" for drilling, milling, boring, and grinding. 31

Electric Temperature Control

LEEDS & NORTHRUP CO., 4934 Stenton Ave., Philadelphia 44, Pa. Bulletin N-33B-621 (1), containing information on maintaining temperature of electric salt pots with Micromax electric control. 32

Precision Gages

PRATT & WHITNEY DIVISION NILES - BEMENT - POND CO., West Hartford 1, Conn. Circular 479, entitled "Gaging with Air by the P & W Air-O-Limit Method." 33

High-Speed Steel

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York 17, N. Y. Data sheet giving complete information on Rex M-2 tungsten-molybdenum high-speed steel. 34

Springs

MUEHLHAUSEN SPRING CORPORATION, 201 Michigan Ave., Logansport, Ind. Booklet entitled "Springs Designed for the Job Improve Product Performance." 35

Air Motors and Air Equipment

BELLOWS CO., 861 E. Tallmadge Ave., Akron, Ohio. "Photo Facts File," containing folder, price list, and photographs of controlled air devices and accessories. 36

Low-Temperature Brazing

HANDY & HARMAN, 82 Fulton St., New York 7, N. Y. Circular describing the advantages of preplacing in low-temperature silver-alloy brazing. 37

Continuous Printing Machine

CHARLES BRUNING CO., INC., 4700 Montrose Ave., Chicago 41, Ill. Circular descriptive of the new Bruning Copyflex Model 2 continuous printer. 38

Carbide Tools

VASCOLOY - RAMET CORPORATION, North Chicago, Ill. Price List No. VR-330, on Vascoloy-Ramet tantalum-tungsten carbide tools and blanks. 39

Horizontal, Boring, Drilling, and Milling Machines

OHIO MACHINE TOOL CO., Kenton, Ohio. Bulletin 1000, on Dreadnaught horizontal boring, drilling, and milling machines. 40

Die-Casting Machines

H. L. HARVILL MFG. Co., P. O. Box 335-C, Vernon, Calif. Bulletin entitled "Die-Cast Your Product with the Revolutionary New Harvill Die-Casting 'Package'." 41

Automatic Plating Machine

UDYLITE CORPORATION, 1651 E. Grand Blvd., Detroit 11, Mich. Circular illustrating and describing the Udylite fully automatic plating machine. 42

Chucks

WESTCOTT CHUCK Co., Oneida, N. Y. Catalogue 600, on independent, universal, and combination chucks, light-duty chucks, and drill chucks. 43

Heat- and Corrosion-Resisting Castings

STERLING ALLOYS, INC., Woburn, Mass. Bulletin 200, "Engineering Data Book on Stermet Heat- and Corrosion-Resisting Castings." 44

Masonite—A Construction Material

MASONITE CORPORATION, 111 W. Washington St., Chicago, Ill. Bulletin entitled "Masonite—A Manual for the Product Designer." 45

Die Bushings and Punches

TOOL CRAFT Co., 1835 Westchester Ave., New York 60, N. Y. Catalogue section on ready-to-use die bushings, punches, and stripper guide bushings. 46

Lock-Nuts

STANDARD PRESSED STEEL Co., Box 22, Jenkintown, Pa. Bulletin on "Flexloc" lock-nuts, which are just being introduced on the industrial market. 47

Fingerprint Neutralizer

E. F. HOUGHTON & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa. Circular describing Houghton's Cosmoline fingerprint neutralizer. 48

Shankless High-Speed Drills

REPUBLIC DRILL & TOOL Co., 322 S. Green St., Chicago 7, Ill. Catalogue on a new type shankless high-speed steel drill. 49

Acetylene Generators

AIR REDUCTION, 60 E. 42nd St., New York 17, N. Y. Bulletin on Airco acetylene generators, featuring a new portable type. 50

Precision Gages

N. A. WOODWORTH Co., 1300 E. Nine Mile Road, Detroit 20, Mich. Catalogue 44-G, containing 84 pages on Woodworth precision gages. 51

Heat-Treating Furnaces

HEVI DUTY ELECTRIC Co., Milwaukee, Wis. Bulletin HD 444, on the Hevi Duty line of electric heat-treating furnaces. 52

Surface Grinders

MATTISON MACHINE WORKS, Rockford, Ill. Bulletin on surface grinders, showing wide range of adaptability to various types of work. 53

Gage-Blocks

FORD MOTOR Co., JOHANSSON DIVISION, Dearborn, Mich. Folder on set No. 2 Johansson gage-blocks, comprising thirty-five blocks. 54

Grinding and Finishing

MINNESOTA MINING & MFG. Co., St. Paul, Minn. Four publications describing the 3-M method of grinding and finishing. 55

Hydraulic Equipment

WATSON-STILLMAN Co., Roselle, N. J. Bulletin 130-A, on hydraulic equipment, valves, and forged-steel fittings for process industries. 56

Hydraulic Devices

LYON - RAYMOND CORPORATION, Greene, N. Y. Bulletin 137, on hydraulic devices developed for specific applications. 57

Welding Electrodes

PAGE STEEL AND WIRE DIVISION, AMERICAN CHAIN & CABLE Co., Monessen, Pa. Informative book on stainless-steel electrodes. 58

Vibration Insulation

HAMILTON KENT MFG. Co., Kent, Ohio. Bulletin describing Rexon

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vibration mounts, a new type of vibration insulation equipment.—59

Ball-Bearing Cleaning Machine

L & R Mfg. Co., 577 Elm St., Arlington, N. J. Folder illustrating and describing the new L & R precision ball-bearing cleaning machine. ——60

Arc-Welding Electrodes

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. Bulletin L6348, describing a new Allis-Chalmers line of arc-welding electrodes. ——61

Flexible Metal Hose

Chicago Metal Hose Corporation, Maywood, Ill. Pamphlet E-144, entitled "Flexible Metal Hose for Every Industrial Use." ——62

Die-Casting Cleaning

Oakite Products, Inc., 26 Thames St., New York 6, N. Y. Instruction book entitled "Production Cleaning of Die-Castings." ——63

Punching Equipment

Wales - Strippit Corporation, North Tonawanda, N. Y. Catalogue CD, on Wales Type CD hole punching system. ——64

Industrial Greases

E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa. Booklet entitled "Houghton's Industrial Greases." ——65

Spotting and Centering Drills

Chicago - Latrobe Twist Drill Works, 411 W. Ontario St., Chicago 10, Ill. Folder on spotting and centering drills. ——66

Hydraulic Presses

Colonial Broach Co., P. O. Box 37, Harper Station, Detroit 13, Mich. Bulletin VJI-44, on Colonial "Junior" hydraulic presses. ——67

Materials Handling

Factory Service Co., 4615 N. 21st St., Milwaukee 9, Wis. Booklet entitled "The Turner System of Materials Handling." ——68

Welding and Brazing Fluxes

Superior Flux Co., 1783 E. 21st St., Cleveland 3, Ohio. Catalogue 44, on fluxes for welding, brazing, and silver soldering. ——69

Sine-Angle Plates

Nichols-Morris Corporation, 50 Church St., New York 7, N. Y. Bulletin on the "Bemisine" sine-angle plate. ——70

Bushing Presses

Watson-Stillman Co., Roselle, N. J. Bulletin 520-A, "Bushing Presses for Railroad Shops." ——71

Rebuilt Machine Tools

Miles Machinery Co., Saginaw, Mich. Catalogue 178, on rebuilt machine tools. ——72

Diamond Tools

Champion Diamond Co., 551 Fifth Ave., New York 17, N. Y. Circular showing the various types of diamond tools made by this company. ——73

Cutting Tools

Robert H. Clark Co., 9330 Santa Monica Blvd., Beverly Hills, Calif. Catalogue 44, on adjustable cutting tools. ——74

Polishing Wheels

Divine Brothers Co., Utica 1, N. Y. Bulletin entitled "Vulcanized-on Rubber Wheels." ——75

Hydraulic Presses

Charles E. Francis Co., Huntington, Ind. Bulletin on hydraulic presses for all types of laminated work. ——76

V-Belts

Diamond Rubber Division of B. F. Goodrich Co., Akron, Ohio. Folder on Diamond wire grommet V-belts. ——77

V-Belts

B. F. Goodrich Co., Akron, Ohio. 74-page "V-Belt Handbook for Industrial Applications." ——78

Materials Handling

Industrial Mfg. Co., 828 N. Broadway, Milwaukee 2, Wis. Folder on all-steel hand trucks. ——79

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 206-236 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in December, 1944, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

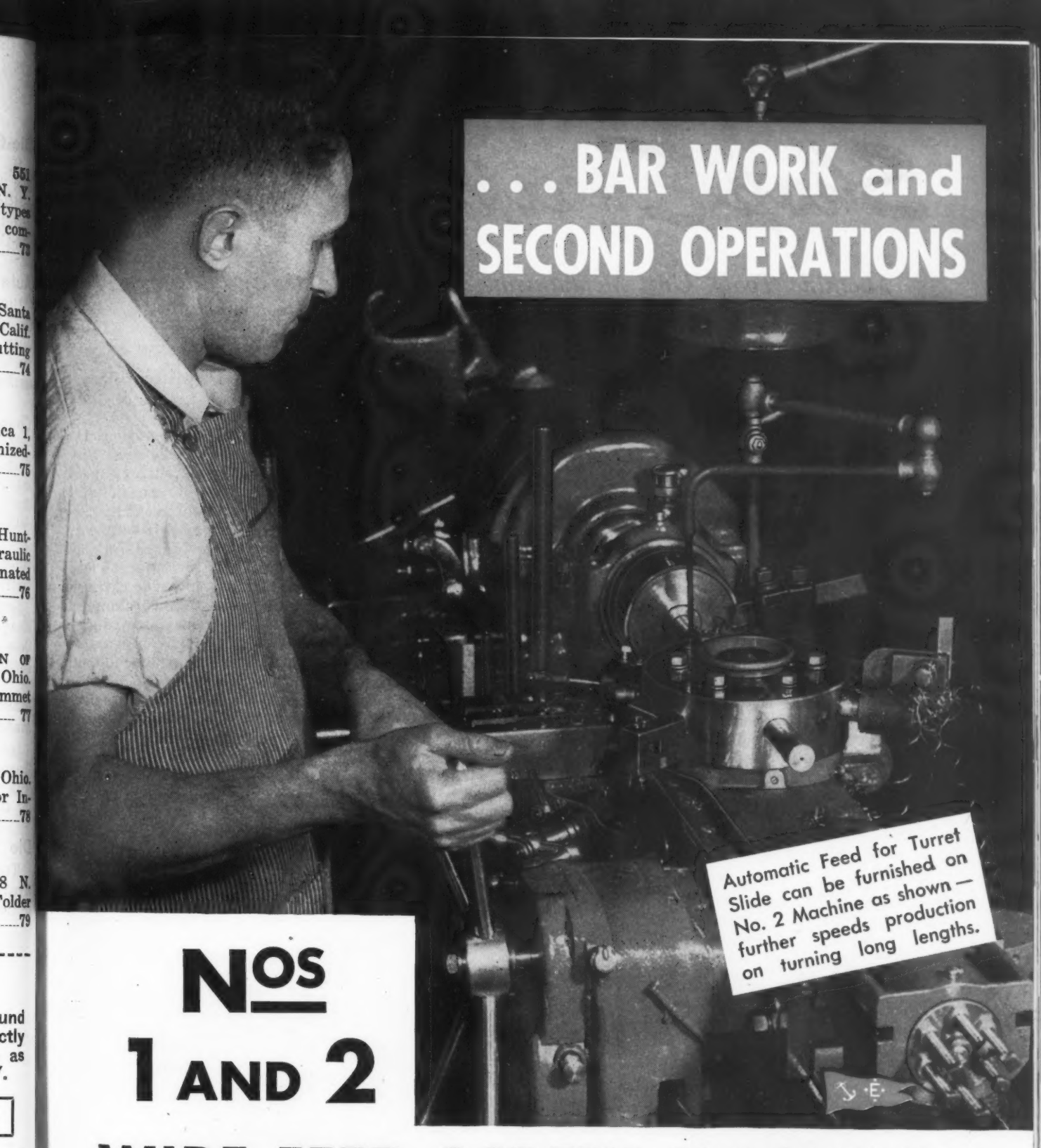
To obtain additional information about any of the materials described on pages 194-195, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning name of material as described in December, 1944, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York 13, N. Y.

[SEE OTHER SIDE]


. . . BAR WORK and
SECOND OPERATIONS
Automatic Feed for Turret Slide can be furnished on No. 2 Machine as shown — further speeds production on turning long lengths.

Nos 1 AND 2

WIRE FEED SCREW MACHINES

★ No. 1 Machine takes stock to ⅝" dia. (⅞" for light work).

★ No. 2 Machine takes stock to 1" dia. (1¼" for light work).

Ask for Booklet giving details

B·S BROWN & SHARPE MFG. CO.
Providence 1, R. I., U. S. A.

have ALL the features for PROFITABLE PRODUCTION — high productive capacity — unusually rapid set-up — simple to operate — stock fed in ¾ second — powered for heavy duty.

BROWN & SHARPE

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Baker Automatic-Cycle Two-Way Boring and Reaming Machine

Baker Bros., Inc., P. O. Box 101, Station F, Toledo 10, Ohio, have recently equipped one of their multiple-spindle 30-HH hydraulic-feed machines for boring and reaming the bearings in both ends of truck axle housings in a single automatic cycle. This machine is especially arranged for double-end two-way operation, and is tooled up to complete four cuts in each of four bearings at each end of the malleable-iron axle housing in one machining cycle, in addition to final line reaming at the last station.

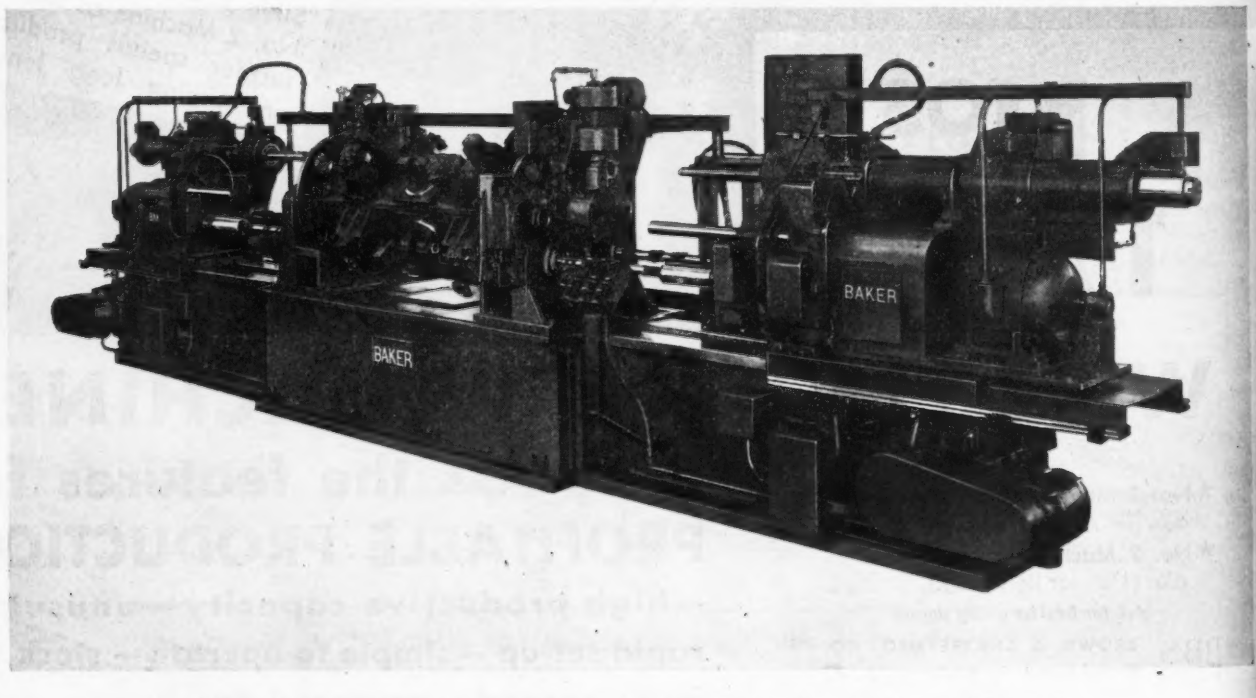
The two spindles in each opposed head on the main saddles of the hydraulic-feed unit perform cutting operations at Stations 2 and 3. The last cutting station of each opposed head is furnished with an independent auxiliary long-travel spindle fitted with a multiple-blade reamer head for each of the four bearings at opposite ends of the axle housing.

The machine has electrical interlocks, and is designed to allow the bars at Stations 2 and 3 to move into their cutting positions without revolving during the positioning movements. The boring-bars are indexed slightly off center while being moved into their cutting positions in the housing. After the bars have been positioned longitudinally, a trunnion arrangement moves them from their offset positions to their true central cutting positions. Rotation of the bars starts automatically immediately after this positioning operation. The feed is gaged and tripped automatically at the end of the machining cut, thus completing the automatic cycle. 81

High-Amplification "Precisionaire"

The Sheffield Corporation, Dayton 1, Ohio, has developed a "Precisionaire" bore-measuring instrument which has the unusually high amplification factor of 20,000 to 1 to 25,000 to 1. This instrument is graduated in increments of five-millionths inch for internal measuring. It has proved extremely rapid and accurate in checking critical internal dimensions on fuel injection equipment having a tolerance of plus or minus five-millionths (0.000005) inch.

The Model 600-0 Precisionaire is suitable for tolerances ranging from 0.0002 to 0.000005 inch with amplification values of 15,000 to 25,000, depending on the part to be checked. In these new Precisionaire instruments, the action of the floating indicator is said to be as quick and stable as in the lower



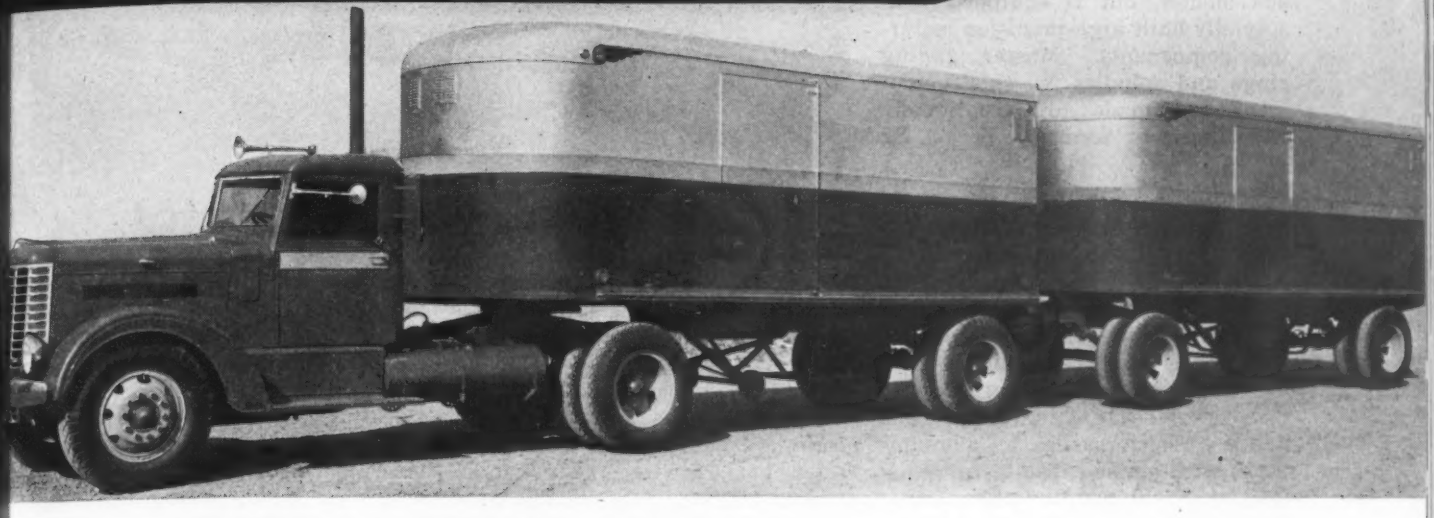
Baker Multiple-spindle Automatic-cycle Machine Designed for Boring and Reaming Both Ends of Truck Axle Housing Simultaneously

To obtain additional information on equipment described on this page, see lower part of page 204.

THE CINCINNATI SHAPER CO.

CINCINNATI OHIO U.S.A.

SHAPERS · SHEARS · BRAKES



TWIN EFFICIENCY

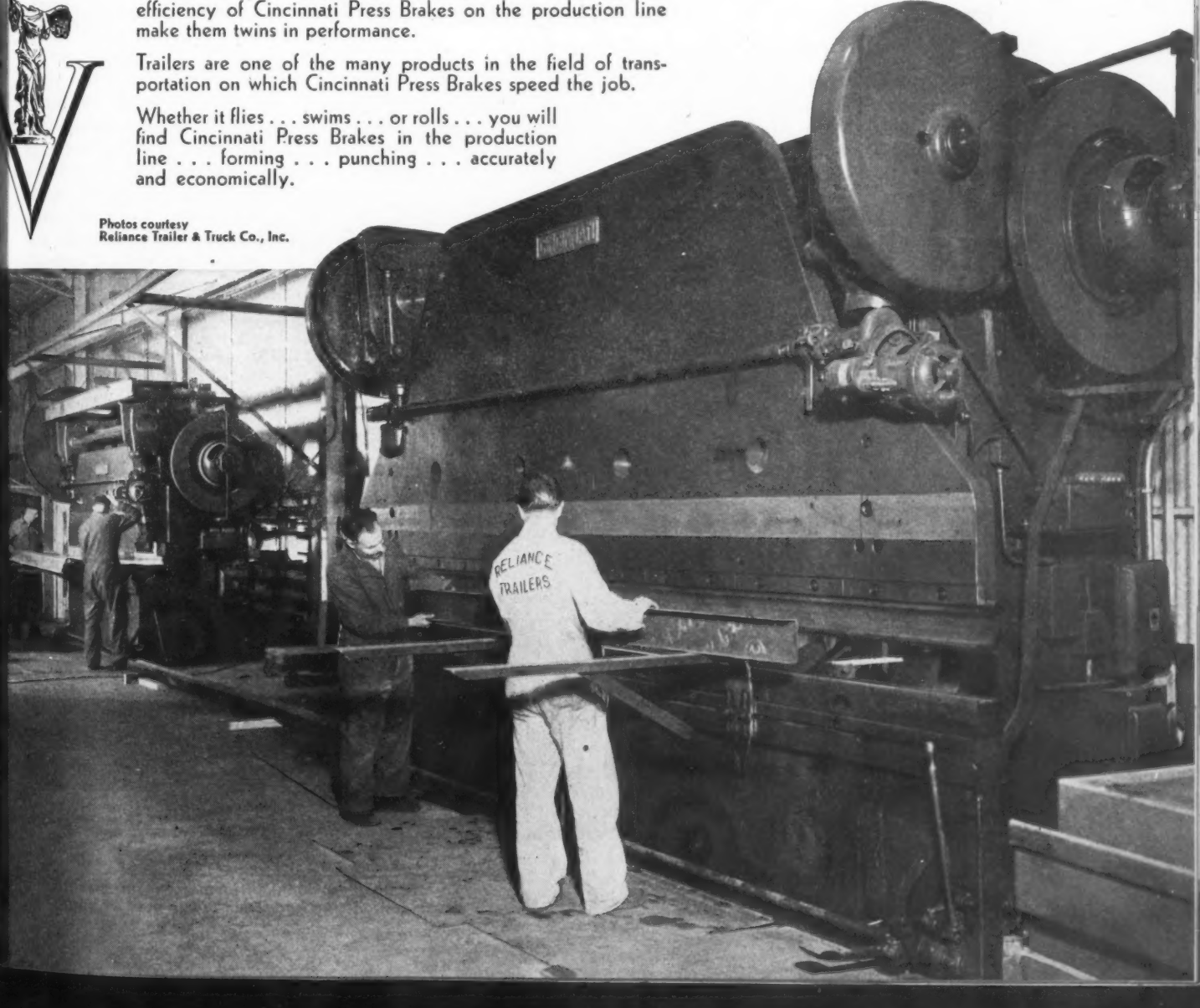
Write for Catalog B-2, a booklet illustrating and describing Cincinnati Press Brake applications.

The efficiency of these Reliance Trailers on the road and the efficiency of Cincinnati Press Brakes on the production line make them twins in performance.

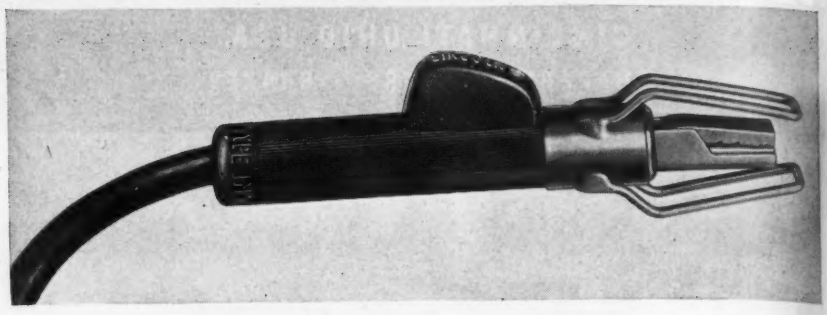
Trailers are one of the many products in the field of transportation on which Cincinnati Press Brakes speed the job.

Whether it flies . . . swims . . . or rolls . . . you will find Cincinnati Press Brakes in the production line . . . forming . . . punching . . . accurately and economically.

Photos courtesy
Reliance Trailer & Truck Co., Inc.



magnification models which have been in use for several years. The base of the instrument has the same general appearance as previous models, but is equipped with specially built high-precision metering components. Master gaging rings and spindles for this instrument are made to exceptionally close limits of accuracy. 82



Lincoln Light-weight Holder for Welding Electrodes

Lincoln Light-Weight Electrode-Holder

A new light-weight, low-cost, insulated holder for welding electrodes has just been announced to the trade by the Lincoln Electric Co., Cleveland 1, Ohio. This holder has a current rating of 300 amperes with ample capacity for overload, and will handle various sizes of electrodes ranging from 1/16 to 1/4 inch in diameter. The jaws are made of a high-conducting and wear-resisting copper alloy known as "Lincalloy," and are fully guarded against contact with the work by a spring steel insulating guard which can be easily replaced. The trigger of the holder is of molded heat-resisting material.

Other features of this "INS" electrode-holder include hollow air-cooled heat-resisting fiber handle, proper balance, and equally good performance on both alternating and direct currents. The holder is designed to grip the electrode securely at any angle and yet permit quick changing of rods. 83

Pratt & Whitney Roll-Thread Comparator with Gaging-Pressure Control

A new roll-thread comparator with gaging-pressure control has just been introduced to the trade by Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn. The pressure control feature of this new gage is designed to enable the operator, or even different operators, to inspect threads with a high degree of accuracy and uniformity, regardless of variations in the users' sense of "feel." The gage also prevents rejection of parts in "border-line" cases, where the operator, gaging by "feel," may have exerted slightly too great pressure on the work in the "Not Go" position. Pilot models of this recent addition to the line of Pratt & Whitney gages have been used for more than a year with satisfactory results in actual close-tolerance thread inspection work.

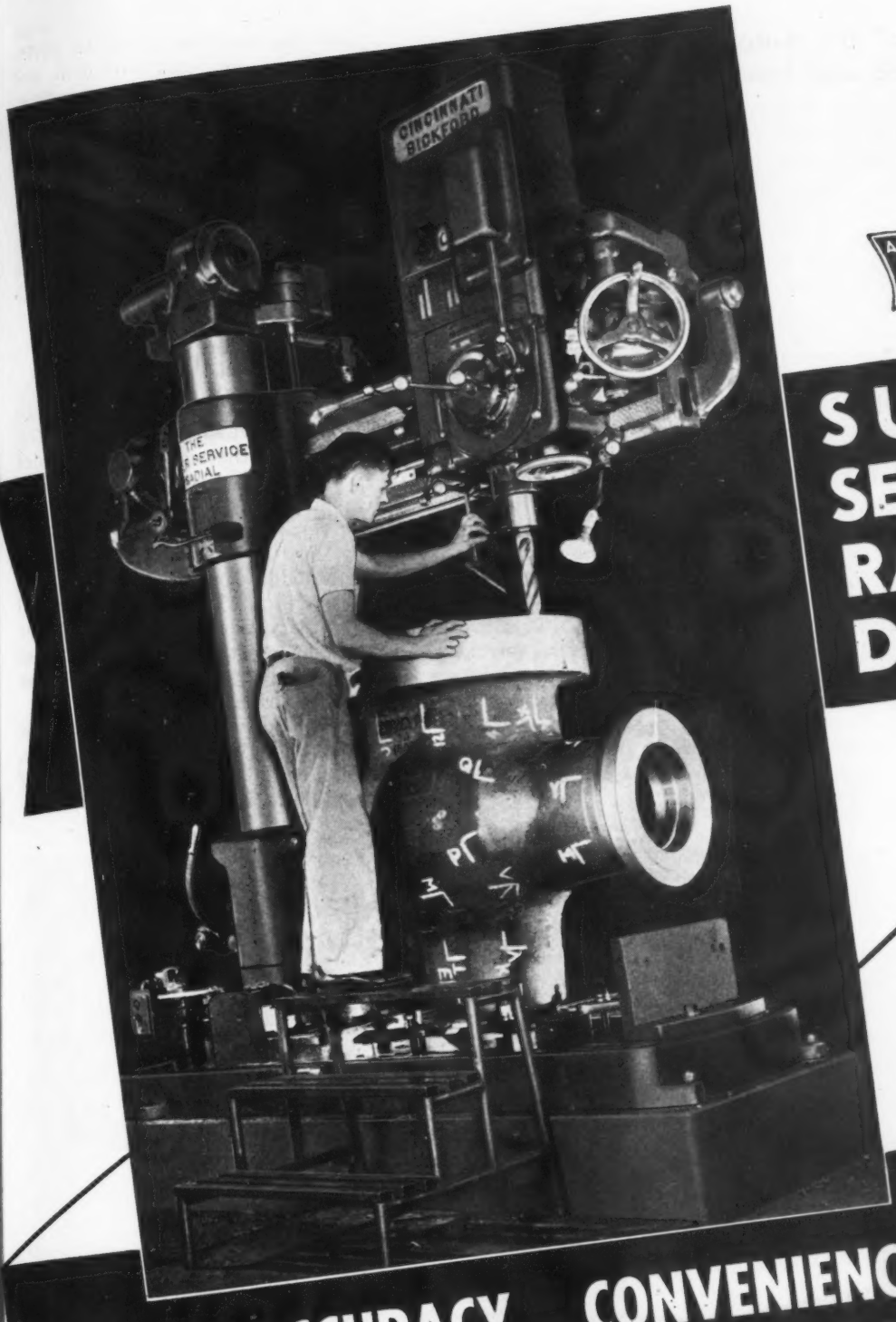
The operation of this gage is based on the same principle of "Go" and "Not Go" thread rolls used in roll-thread snap gages made by Pratt & Whitney for many years, and more recently by licensees of this company. The roll-thread principle is combined with a dial-indicator pressure control on both sets of rolls to facilitate very close tolerance thread inspection. As the work passes between the "Go" rolls any movement of the dial pointer indicates an over-size thread. On the other hand, as the work contacts the "Not Go" rolls the pointer must move if the thread is correct. If the pointer does not move when the thread is between the "Not Go" rolls, the work is under size.

Roll-thread Comparator with Gaging-pressure Control Brought out by Pratt & Whitney Division Niles-Bement-Pond Co.

The comparator consists of a rigid-base casting and main frame which carries the indicator bracket, as shown in the illustration. The frame carrying the upper pair of rolls makes contact with the indicator, and is supported by reeds which provide for a vertical motion. The lower pair of rolls is supported in a frame which is adjustable on its slide, but can be securely locked in the desired position. A vertical adjustable screw stop holds the two roll frames apart at the exact setting required to locate the pointer of the dial indicator in the zero position.

The gage is adjustable over a range of from 1/4 inch to 1 1/2 inches in diameter and uses a gaging pressure of approximately 2 pounds. The 0.0001-inch indicator graduations allow the gage to be used for size classifying inspection. The gage is 12 1/2 inches high and weighs approximately 16 pounds. Thread rolls of any desired pitch are available as well as "Go" and "Not Go" setting plugs designed for use in precision gaging any given thread. 84

To obtain additional information on equipment described on this page, see lower part of page 204.



ARMY E NAVY

SUPER SERVICE RADIAL DRILLS

SPEED...ACCURACY...CONVENIENCE—ON TOUGH DRILLING JOBS!

A "jumbo" job on a jumbo valve made of carbon molybdenum steel—and the Super Service Radial Drill does it with plentiful, smooth power and with the speed and accuracy made urgent by today's war needs. The machine is one of the battery of Super Service Radials in the plant of The Edward Valve and Manufacturing Co., Inc., of East Chicago, Ind. Work consists in drilling bolt holes on the bonnet flange of the body casting of a 14" valve for service at 1500 lb. pressure at 950°F. Note ruggedness of the machine—and low, convenient control levers that set a new standard for fast handling! Complete details sent upon request. The Cincinnati Bickford Tool Co., Oakley, Cincinnati 9, Ohio.

"Drivmatic" for Automatically Drilling Work and Inserting Rivets

The General Engineering Co., 785 Hertel Ave., Buffalo, N. Y., has just placed on the market a new machine designated the "Drivmatic," which, when a foot-switch is depressed, automatically drills and countersinks the work, feeds a rivet into the drilled hole, and heads the rivet in one continuous cycle. In performing this operation, the machine selects the proper length rivet for the thickness of stock to be riveted. Rivets of different lengths are carried in from one to five magazine tubes at the left of the machine head, the number of rivet lengths used depending on the variations in the thickness of the work.

The drilling operation can be stopped at any point and the cycle started over again by simply releasing the foot-switch. All operations are electrically interlocked, so that the machine will stop automatically if any part fails to reach its correct position at the proper time. Air blasts or streams are delivered automatically under proper timing control both above and below the work to clear the drill chips from the work surface and the lower anvil.

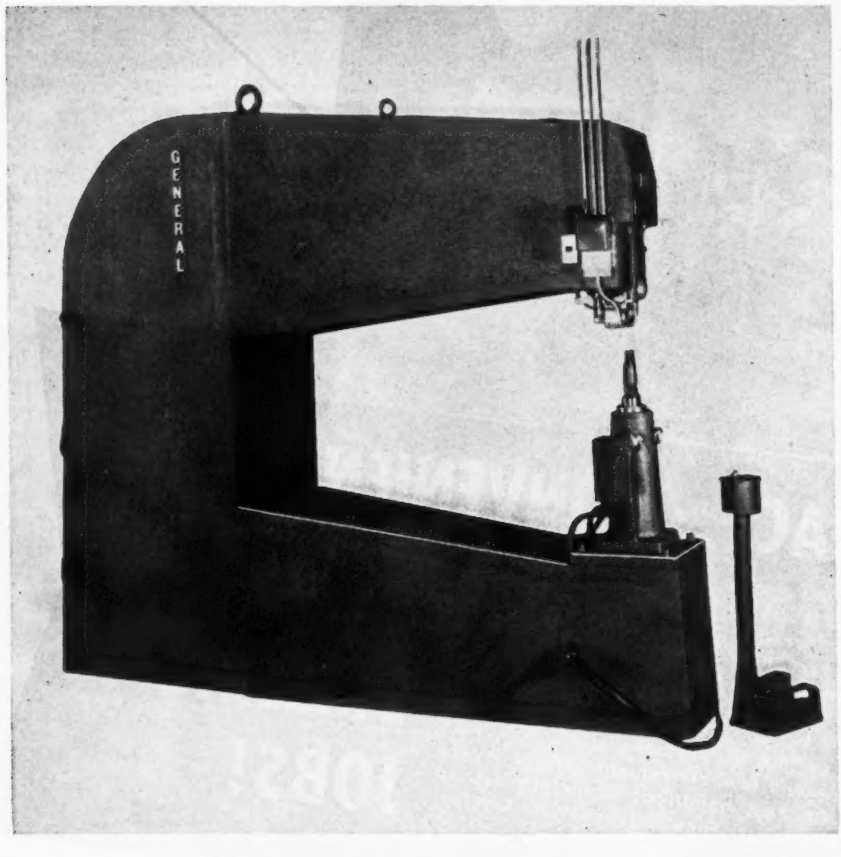
The pedestal control box of the machine is equipped with a four-point switch by means of which the machine can be controlled to perform the complete automatic cycle, rivet only, drill only, or drill and place the rivet ready for heading. Up to five different lengths of rivets having the same diameter can be handled on the machine. When a different diameter rivet is used, only three small parts in addition to the rivet-feeding device need to be changed in order to make the machine ready for operation.—85

Bliss Press Built for Powdered-Metal Industry

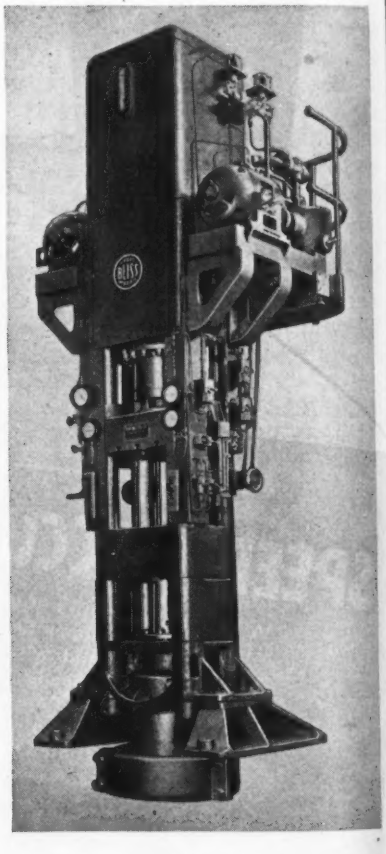
A duplex hydro-dynamic 200-ton press, designed especially for pressing deep sections and flanged objects in powdered metals that require one portion of the work to be pressed at a different speed from another, has been brought out by the E. W. Bliss Co., Department P.M., 53rd St. and Second Ave., Brooklyn 32, N. Y. This press has independent pressure, stroke, and speed controls for each slide. Separate pumping units are also furnished for each slide, so that the relationship between the speeds of the two slides can be varied to suit the work.

Automatic cycle operation can be employed, which includes the following functions listed in the order in which they are performed: (a) Quick closing to make contact with the work; (b) simultaneous pressing by the two slides at predetermined adjustable speeds and pressures; (c) automatic reversal of upper slide; (d) use of lower slide as ejector; (e) timed pause for loading; and (f) automatic return of lower slide.

Although the press shown in the illustration is of 200-ton capacity, it can be built in capacities ranging from 50 to 5000 tons. Optional fea-



"Drivmatic" Automatic Drilling and Riveting Machine Brought out by the General Engineering Co.



Bliss Duplex Hydro-dynamic Press for Powdered-metal Work

To obtain additional information on equipment described on this page, see lower part of page 204.

"Aircraft Quality" GEARS

OFFER ADVANTAGES FOR YOUR PRODUCT

War urgency demands the seemingly impossible of men and machines. Before the war the "aircraft quality" gears that Foote Bros. are today producing were hardly more than an engineer's ideal.

Today these gears, closely approaching theoretical perfection, are flowing off Foote Bros.' production line by the hundreds of thousands.

"Aircraft quality" gears were developed to meet the exacting demands of the powerful Pratt & Whitney engines. Light weight and tremendous strength—the ability to stand high speeds and heavy loads, and yet assure long life were essential. Despite extremely thin sections, "aircraft quality" gears must carry tooth loads far in excess of values customarily considered safe design and must operate at pitch line velocities that can be measured in miles per minute.

These unique qualities of Foote Bros. "aircraft quality" gears offer many advantages to manufacturers of equipment requiring the transmission of power. Right now in the drafting room and experimental laboratories of many of these manufacturers—designs for tomorrow's peacetime machines are being developed—new machines whose performance will be improved by the Foote Bros. gears incorporated in their design.

"Aircraft quality" gears may solve problems for your engineers—they will assure higher speed, longer life, lighter weight, more compact design—they may even make possible new developments that otherwise would be impractical.

To aid your engineers in determining the advantages which "aircraft quality" gears will bring to your product, our engineering department is now developing an engineering manual which should be in the hands of every designing engineer—every production man—facing problems of power transmission. A copy will be sent on request as soon as it is ready.

* * *

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. P, 5225 S. Western Blvd. • Chicago 9, Illinois

This informative product engineering manual on "aircraft quality" gears contains data on a new and revolutionary type of precision gear. A copy will be sent to you on request as soon as it is ready.

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION
5225 S. Western Blvd., Chicago 9, Ill. Dept. P

Please send me a copy of the Engineering Bulletin on "Aircraft Quality" Gears as soon as it is available.

Name.....

Position.....

Company.....

Address.....

City.....*State*.....

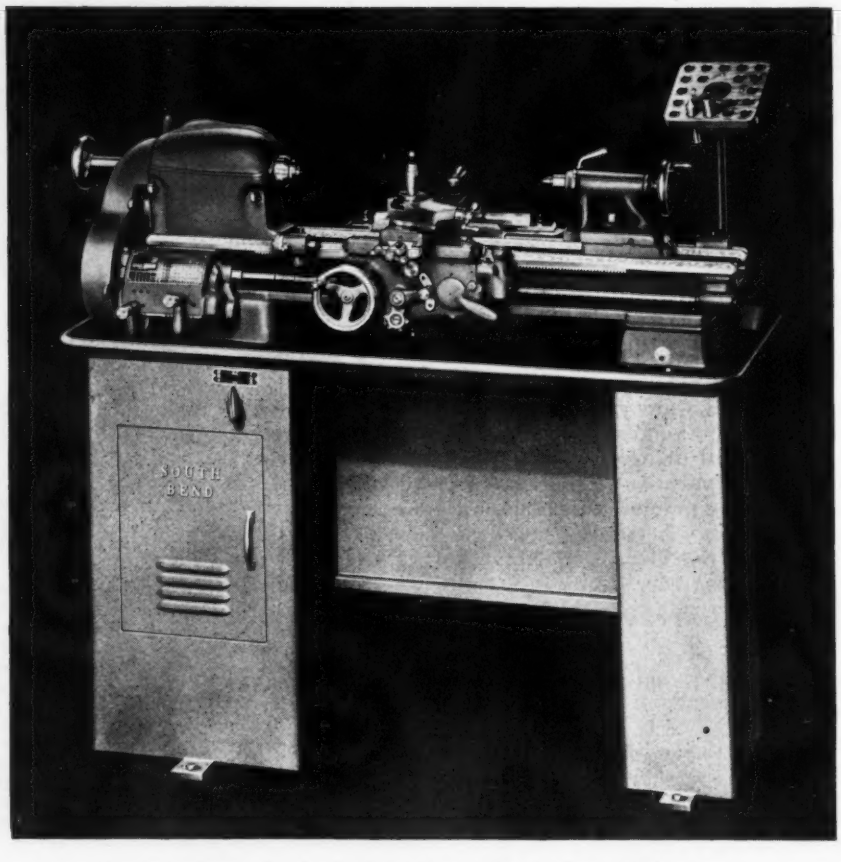
tures include automatic loading devices and core rods for bushing work. The electric control of this press permits the sequence of its functions to be readily changed in the event that a new type of work requires a different operating sequence of the slides. ----86

South Bend Tool-Room Lathe

A new 9-inch lathe has been developed for exacting tool-room or production work by the South Bend Lathe Works, 424 E. Madison St., South Bend 22, Ind. This lathe has a 9 1/4-inch swing and will take work 22 inches in length between centers. It has a maximum collet capacity of 1/2 inch and a 3/4-inch spindle bore.

The twelve spindle speeds range from 41 to 1270 R.P.M., other speeds below this range being furnished by the back-gear drive. A quick-change gear-box permits cutting forty-eight different screw threads ranging from 4 to 224 threads per inch. The gear-box also provides forty-eight power longitudinal feeds and power cross-feeds.

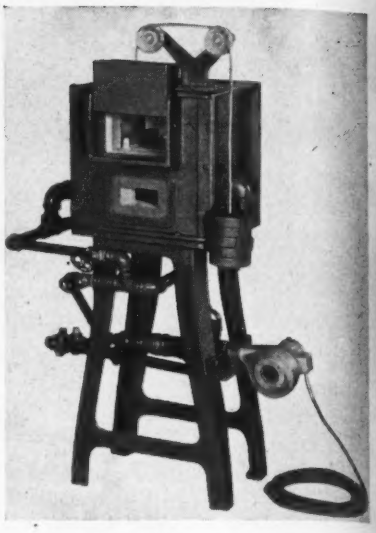
The lathe is equipped with a handwheel, draw-in collet attachment, collet rack, taper attachment, thread dial indicator, thread cutting stop, large and small faceplates, and micrometer carriage stop. Additional attachments designed to simplify the machining of special classes of work are also available. ----87



Tool-room Lathe Built by South Bend Lathe Works

Barkling Multi-Purpose Tool-Room Furnace

A pedestal type, multi-purpose, heat-treating furnace is now being built by the Barkling Fuel Engineering Co., 400 N. Paulina St., Chicago 22, Ill., which has three different work-heating areas. It has an indirect heating chamber, with a door 4 1/2 by 8 inches, for use in hardening, annealing, stress-relieving and carburizing; a direct heating chamber, with opposed openings at the front and back of 2 by 4 1/2 inches, for use in heating tools requiring dressing, forging, and bending operations; and a tempering surface on the top of the furnace for drawing tools and dies.



Multi-purpose Heat-treating Furnace Built by Barkling Fuel Engineering Co.

The indirect heating chamber has a U-shaped hearth 6 inches between the ribs and 8 inches deep, which can be inserted through the door when replacement is necessary. The interior of this chamber has an area of over 410 cubic inches, and will heat work to a temperature of 1500 degrees F. in 10 minutes or to 1900 degrees F. in 29 1/2 minutes. Temperatures up to 2500 degrees F. can be obtained in the direct heating chamber.

It is claimed that the Barkling air relief valve used in this furnace makes possible the maintenance of constant heats without the customary fluctuations. The valve, operating in conjunction with a specially designed blower, eliminates variations in pressure. The furnace is 25 inches wide, 19 inches deep, and 53 inches high. ----88

"Borcoloy" Tool Bits

A new ferrous metal-cutting alloy known as "Borcoloy," with outstanding wear resistance and red hardness characteristics obtained, respectively, by the alloying agents boron and cobalt, has just been brought out by General Aircraft Equipment, Inc., Tool Division, South Norwalk, Conn. A unique method of centrifugally casting these tool bits makes possible the addition of these two potent elements to the basic alloy,

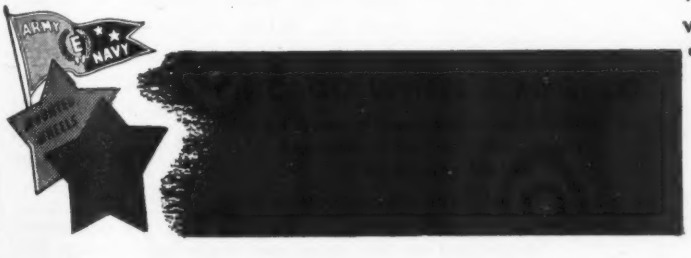
To obtain additional information on equipment described on this page, see lower part of page 204.

● Geared to the precision demands of war, Chicago Wheels have been a potent force in smashing bottlenecks —cutting down rejects—speeding production to an all-time high.

Constantly tested, constantly improved—Chicago Wheels produce finishes so perfect they pass exacting surface analyzer tests, so accurate they can be measured in micro inches.

Production of civilian goods will demand the same precision finishing methods.

Keep pace with Chicagos, the Wheels of Progress!



CHICAGO GRINDING WHEELS

Anything up to 3" in diameter in various grains and bonds, including FV, the sensational new bond with a pedigree.

CHICAGO MOUNTED WHEELS

Shapes and abrasive formulas to take care of every job of internal or external finishing.

TRY ONE FREE!

So you'll know what they can do, we will send a test wheel. Tell us material you'd like to finish and size wheel required.

MR-12

Send Catalog. Interested in ☐ Grinding Wheels

☐ Mounted Wheels. ☐ Send Test Wheel. Size.....

Name.....

Address.....

giving room temperature hardness values as high as Rockwell C 70. Even better hardness values can be obtained to meet special requirements.

Two grades of Borcoloy are available. Grade 5 Borcoloy with 12 per cent cobalt is recommended for hogging and heavy-duty cutting on high alloy steels, heat-treated bar stock, or forgings. Its red hardness enables it to hold a keen cutting edge at very high temperatures. This grade is used only for solid tool bits.

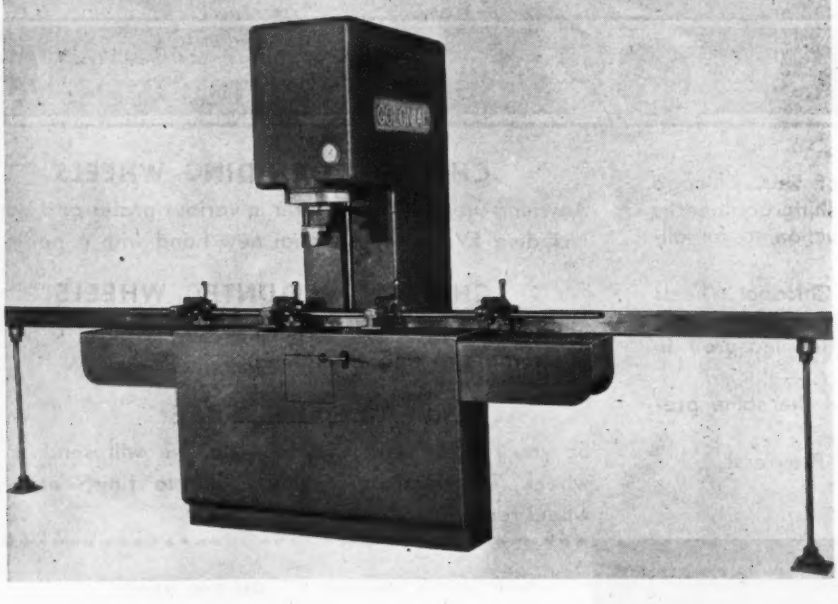
Grade 6 Borcoloy with 20 per cent cobalt is recommended for rough-turning work, as well as fine finishing at speeds too high or on material of too abrasive a nature for successful machining with high-speed steel tool bits. Its red hardness is greater than that of Grade 5. This grade is available in solid tool bits, as well as in tipped tools. Both grades of Borcoloy can be ground on ordinary tool-room equipment, using a medium-fine or fine grain wheel with medium-hard bond. ——89

Colonial Hydraulic Straightening Presses

A line of hydraulically operated straightening presses equipped for accurate pressure control has been brought out by the Colonial Broach Co., Box 37, Harper Station, Detroit 13, Mich. The new presses are available in a number of capacity ratings ranging up to 50 tons, and are designed for straightening both finished and rough work, including shafts and forgings. They are of reinforced welded steel construction, and are equipped with a built-in motor and a direct-acting hydraulic cylinder that is built into the machine head. Sensitive control is obtained by light pressure on the hand-control and foot-pedals. A gage indicates the exact amount of pressure applied to the work.

The straightening fixtures are equipped with either center or roller type work supports as required for handling finished or rough work. These supports are mounted on a long guide rail which is especially adapted for use in straightening long shafts, since they prevent sagging of the work beyond the supporting anvils.

An important feature of the work supports is their free-action roller mounting on the guide rail. This arrangement facilitates rapid shifting of the supports to either side of the ram for supporting the work at various points during the straightening operations. The ram nose and work support anvils for this line of hydraulic straightening presses can be furnished in bronze instead of steel, if desired, for the protection of finished surfaces on the parts to be straightened. ——90



Colonial Hydraulically Operated Straightening Press Equipped for Accurate Pressure Control

De Laval Fan-cooled Worm-gear Speed Reducer

De Laval Fan-Cooled Worm-Gear Speed Reducer

Forced air-cooling is employed in a new worm-gear speed reducer brought out by the De Laval Steam Turbine Co., Trenton 2, N. J. The fan-cooled unit removes the heat from the gear reducer so effectively that the capacity of the gear is doubled for practically all ratios and sizes at 1750 R.P.M. This permits the use of smaller, lighter, and less expensive speed reducers without sacrificing efficiency or durability.

As shown in the illustration, a fan mounted on the worm-shaft draws air at high velocity over and around heat dissipating ribs on the air side of the oil reservoir around the gearing. The use of a double wall increases the effectiveness of the cooling system by confining the cooling air to the housing and thus securing the close air-to-metal contact necessary for maximum heat transfer. ——91

Republic Improved Thread and Plug Gages

A new long wearing, extremely hard gage, known as the V-nide, has been developed by the Republic Gage Co., 2228 Fenkell Ave., Detroit 21, Mich. This new gage is said to derive its long wearing qualities from an extremely hard case having a Rockwell hardness of C73 to 75, which is obtained by a special heat-treating process. The

To obtain additional information on equipment described on this page, see lower part of page 204.

Which Ozalid machine was designed for your drafting room?

A Model B . . . Like Grumman's
Grumman Aircraft Engineering Corp.
Bethpage, Long Island, New York

A Model F . . . Like Blaw-Knox's
Blaw-Knox Corporation
Pittsburgh, Pennsylvania

A Type 2600 . . . Like Standard Oil's
Standard Oil Company of New Jersey
Elizabeth, New Jersey

1. For large-scale print production. An Ozalid Model B will turn out whiteprints of your engineering drawings at speeds up to 20 feet per minute. Printing and Dry Developing are done in one continuous operation . . . and there are many exclusive features.

It can be relied upon for dependable and economical round-the-clock performance. *Price $2,850.00 F.O.B. Johnson City, New York.*

2. For medium production. The Model F is ideal when demands are moderate or occasional. It may also be used to supplement other equipment, or provide on-the-spot printmaking in departmentalized organizations.

The printer and developer are combined in one compact unit and whiteprints can be turned out at speeds up to 4 feet per minute. *Price $825.00 F.O.B. Johnson City, New York.*

3. For use with your present printer. If you have already installed expensive blueprinting equipment . . . you can add a Type 2600 Dry Developing unit and receive all the benefits of Ozalid Printmaking.

Expose Ozalid sensitized materials in your printer—then transfer to the Type 2600. Rate of development is approximately 5 feet per minute. *Price $370.00 F.O.B. Johnson City, New York.*

YOU CAN'T HAVE THIS VERSATILITY—WITHOUT AN OZALID MACHINE

Ozalid's Dry Development distinguishes it from all other printmaking processes. It eliminates baths, driers, plumbing connections—is responsible for compact machine design.

What's most important, it allows you to use a full line of sensitized materials and obtain exclusive printmaking "extras".

WITH OZALID YOU CAN:

Make prints having blue, black, maroon lines on white backgrounds.

Produce duplicate "originals"; reclaim soiled or worn tracings; eliminate drafting waste when making corrections.

Use cut sheets as well as roll stock—eliminate trimming waste.

Turn out all prints in the same manner. No variations in production.

WRITE FOR CATALOG AND SAMPLES OF OZALID WHITEPRINTS.

OZALID PRODUCTS DIVISION

GENERAL ANILINE AND FILM CORPORATION

JOHNSON CITY, N. Y. ★ OZALID IN CANADA—HUGHES OWENS CO., LTD., MONTREAL

hard case is carefully drawn to remove brittleness, such as is usually produced by casehardening.

Other qualities claimed for V-nide gages include same coefficient of expansion as steel; availability in "W" tolerances; extreme hardness with tough core; same "feel" as tool-steel gages; and ability to take a high finish. ——92

Harvill Cold-Chamber Die-Casting Machine

The H. L. Harvill Mfg. Co., Box 335-P, Vernon, Calif., has brought out a high-production cold-chamber die-casting machine designed to fit into metal-working production lines. This machine, shown in Fig. 1, is of the high-pressure cold-chamber type and embodies several new features. The patented die-locking toggle arrangement, shown in Fig. 2, insures positive die closing, which eliminates or substantially reduces the amount of metal flash at the parting line of the dies.

An integral two-stage hydraulic system delivers emulsified water hydraulic fluid at low pressure for the operation of the various members of the machine, and delivers high-pressure fluid for the injection of aluminum-, magnesium-, and copper-base alloys. The pressure of the injection piston on the molten metal may be as high as 88,000 pounds per square inch, although the normal operating pressure is 35,000 pounds per square inch. Compactness of design and simplicity of operation are features of the fully enclosed hydraulic system. A central source of hydraulic power can be used in place of the individual unit system in the case of multiple installations.

The machine shown in Fig. 1 is a standard model which operates at 400 cycles per hour. The equipment of this machine is designed to pull cores from the die in four directions. This standard all-purpose die-casting machine serves as the basic model for special-purpose machines designed to suit specific requirements. —— 93

Sheffield "Threadchek" for Close-Limit Thread Gaging

A type of gaging instrument designed to make possible a more complete check of threaded parts has been placed on the market by the Sheffield Corporation, Dayton 1, Ohio. The operating principles of the indicator snap gage and the thread-roll snap gage have been incorporated in this instrument to permit checking threads to closer limits than is possible with the regular thread-roll snap gage made by this company.

As shown in the illustration, the "Threadchek" is similar to a thread-roll snap gage, except that a standard balanced type indicator with 0.0001-inch graduations is mounted on the roll-holder. The instrument has the same "Go" and "Not Go" rolls; the top "Not Go" roll, however, is not fixed, its movement being registered on the indicator which shows how much the pitch diameter is over or under size. A free rotating back-stop locates the thread when it is presented to the "Not Go" rolls, and thus eliminates the possibility of "cocking." No trained sense of "feel" in making the "Not Go" check is needed.

"Threadchek" Close-limit Thread Gaging Instrument Made by the Sheffield Corporation

If a part passes the "Go" rolls, the lead, thread angle, and pitch diameter are shown to be within the maximum tolerance limits required to permit assembling. If the pitch diameter is shown to be correct by the indicator when the part is presented to the "Not Go" rollers, the lead must also be correct. Correctness of the form or angle can be checked visually as the work is passed through the full thread form ribs of the "Go" roll. When the part is placed in contact with the "Not Go" rolls, the indicator shows any out-of-round condition.

The instrument can be placed in the standard thread-roll snap stand and used at the bench for the rapid checking of parts. ——94

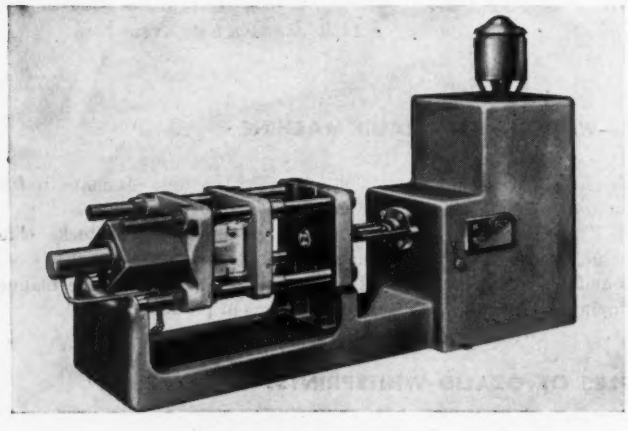


Fig. 1. Cold-chamber Die-casting Machine Built by H. L. Harvill Mfg. Co.

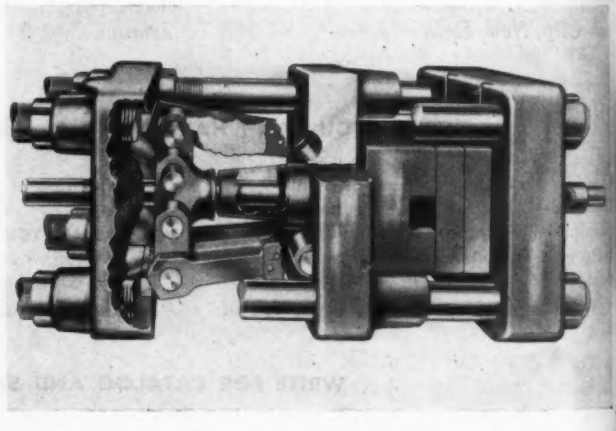


Fig. 2. Die-locking Toggle Arrangement of Harvill Die-casting Machine

To obtain additional information on equipment described on this page, see lower part of page 204.

. . . *it is later than you think!*

Plan *Now* to EX-CELL-O*ize* for Tomorrow's Production Needs

NOW is the time to prepare for needs immediately ahead . . . for tomorrow's keener competition that will make more efficient production methods essential. Your production problems may readily be solved by special-purpose machines that perform multiple operations . . . machines designed and built to meet your specific requirements. Ex-Cell-O has had many years of practical experience in *precision engineering* special-purpose machines that combine improved accuracy and finish with greater production and worthwhile economy. Get in touch *today* with Ex-Cell-O at Detroit or with any of its field engineers in 32 other industrial centers both in the United States and Canada.

EX-CELL-O CORPORATION
DETROIT 6

Ex-Cell-O Style 61 Cylinder Boring Machine, used to finish bore connecting rods

PART: *Aircraft motor accessories drive housing*

MATERIAL: *Magnesium*

OPERATION: *Finish bore and face five periphery holes*

MACHINE: *Ex-Cell-O No. 61 Cylinder Boring Machine*

One Ex-Cell-O machine now does the work on this part where previously four other machines were required. The big saving in machines, fixtures, operators and floor space is readily apparent.

1919 XLO 1944
EX-CELL-O *for* PRECISION

Where increased production, high accuracy, and greater economy through multiple operations are required . . . consult EX-CELL-O.

Bullard Twin-Spindle Mult-Au-Matics

The Bullard Co., Bridgeport 2, Conn., has just announced the development of twin-spindle Mult-Au-Matics, designed to double production on these machines when they are used on the smaller classes of work for which they are adapted, including operations such as boring, turning, facing, drilling, and reaming. Having twin spindles at each of the six or eight stations gives these machines a total of twelve or sixteen spindles. Two of the spindles are used at one station for chucking while the remaining spindles are engaged in machining operations. Twin tooling equipment on the head at each station performs identical operations on the work held in each of the twin chucks.

Both the twin six-spindle and the twin eight-spindle machines have a capacity for handling work 8 inches in diameter by 10 1/2 inches in height. The three-jaw universal chucks are 10 inches in diameter and are hydraulically operated. The clamping pressure of the chucks is adjustable from 100 to 8000 pounds per jaw. The speed of the spindles at each station can be individually adjusted to suit the requirements. Forty-one speed changes available for the spindles range from 64 to 583 R.P.M. There are eighty-two changes in the rates of feed per revolution of the spindle, which range from 0.003 to 0.126 inch. A still wider range of speeds is available by merely changing the back-gears.

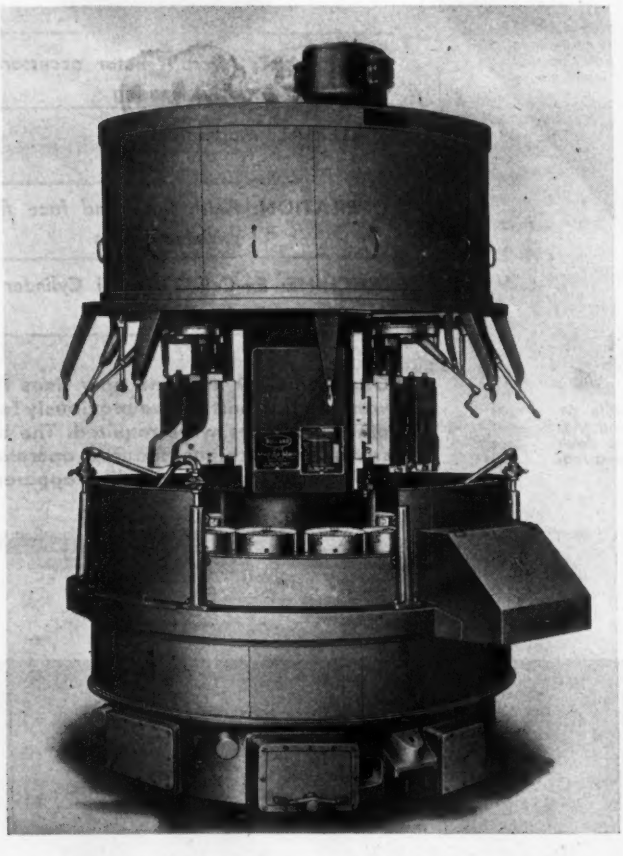
The new Mult-Au-Matics can be obtained with a variety of tool-heads, including a plain vertical tool-head, a plain compound tool-head, and a universal tool-head.

For work requiring drilling operations, duplex live-spindle drill heads can be applied at any working station. Variable individual spindle speeds for these drill heads can be obtained by change-gears. Special heads can be supplied for multiple drilling operations. The Type DF twin six-spindle machine weighs 27,000 pounds, and the eight-spindle machine 36,000 pounds. The six-spindle machine requires a floor space 78 1/2 inches in diameter, and the eight-spindle machine a floor space 87 1/2 inches in diameter. The height from the floor to the motor base is about 140 inches. Motors up to 50 and 60 H.P. can be used. ——— 95

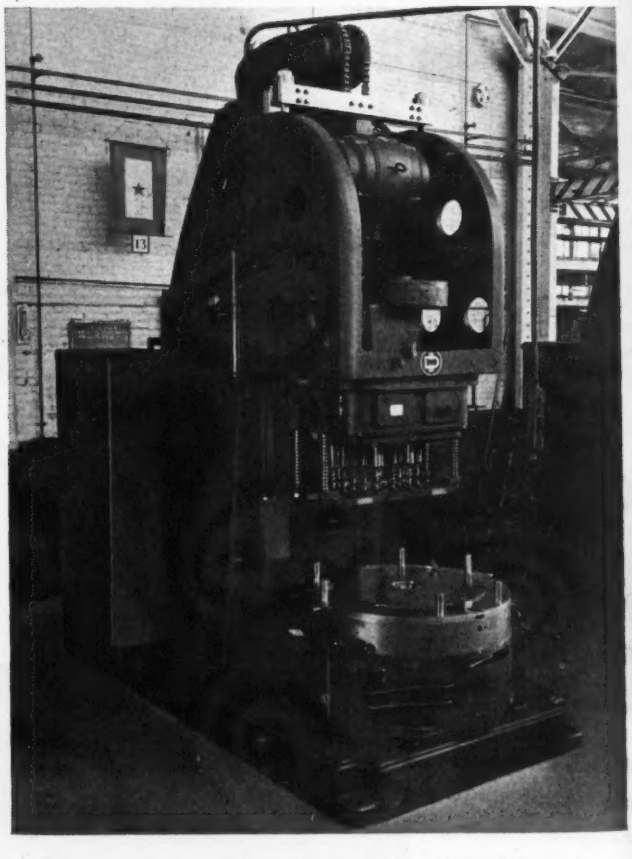
Defiance Heavy-Duty Drilling Machine

A heavy-duty, vertical drilling machine designated No. 540, which is adapted for single- or multiple-spindle drilling, boring, reaming, or milling operations, has been brought out by the Defiance Machine Works, Inc., Defiance, Ohio. The column of this machine consists of a heavy cored casting with long ways which carry the head slide and which are lubricated by a Bijur oiling system. The column supports the hydraulic feed cylinder that operates the head and also encloses the weights that counterbalance the head and slide.

Automatic cycle operation consists of rapid approach, feed, and



Twin-spindle Mult-Au-Matic Developed for the Rapid Handling of Small Work



Defiance Heavy-duty Drilling Machine Adapted for Single- or Multiple-spindle Operations

To obtain additional information on equipment described on this page, see lower part of page 204.

rapid return to the starting position. The cycle can be arranged with a dwell at the end of the feeding movement if desired. The drive to the head is by multiple V-belt and a pair of pick-off change-gears which can be selected to give a speed within the range of 200 to 500 R.P.M. The main drive bracket and head are automatically lubricated.

The machine shown in the accompanying illustration has a twenty-eight-spindle head and fixture designed for drilling 11/16-inch holes in large-diameter plates 3/4 and 3/8 inch thick. For this operation, the machine is equipped with a 42-inch indexing table. Each time the index-pin is disengaged, the table is raised slightly by a lifting device, which allows it to be indexed easily on a ball thrust bearing. The index-pin and lifting device are controlled by a hydraulic cylinder. The table must be in the proper position before the automatic cycle of operations can be started.

The machine is driven by a 25-H.P., 1800-R.P.M. motor. The distance from the spindle to the face of the column is 26 inches; stroke of head, 20 inches; length of head guide on column, 60 inches; over-all width of ways on column, 28 inches; size of base, 60 by 118 inches; weight, 39,150 pounds.....96

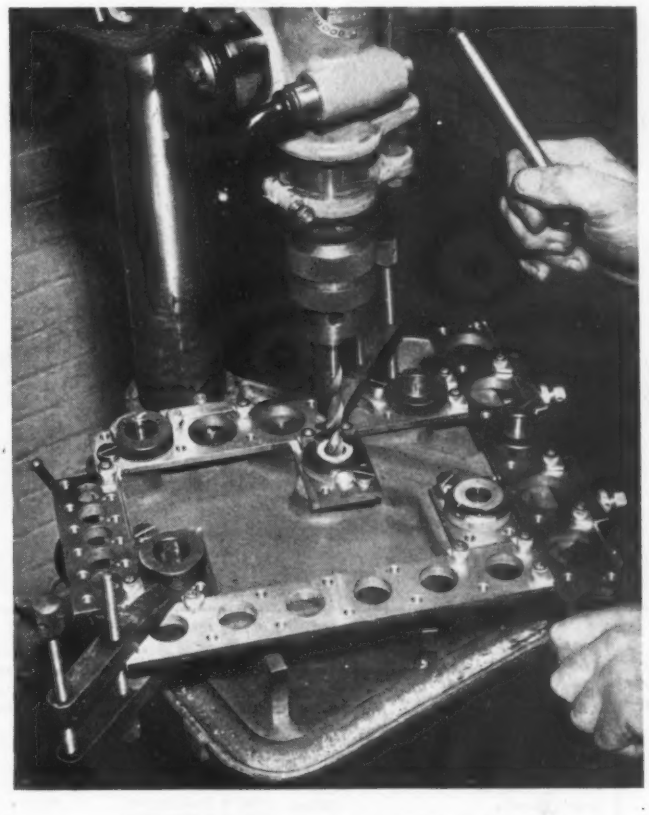
"Borlocator" for Fabricating Jigs and Fixtures

Steel Tools, Inc., 2307 Prospect Ave., Cleveland 16, Ohio, has developed a set of 150 precision components designated the "Micro-King Borlocator" which makes possible quick assembling of a wide variety of accurate production jigs and fixtures. Included in this equipment are master location plates that can be assembled to conform to any lay-out by means of special locking clamps and screws, combinations of drill jig bushings, and drill bushing adapters with lock-screws which can be mounted on the location plate according to the center distances specified for the holes to be drilled.

In using these master plates and bushings, locating pins are inserted in the drill bushings before the final locking up of the assembled components. With a vernier caliper set for hole center-to-center distance plus one-half the diameters of the respective locating pins, measurements are made over the pins of a pair of bushings, a light tapping of one bushing plate serving to obtain the final setting within 0.001 inch or less. A fixture made up in this way will locate holes properly and uniformly on castings or work-pieces, adjusting blocks and screws being provided which can be positioned at suitable points around the assembly.

"Borlocators" are being used for inspection fixtures, as well as for production jigs. The bushings and pins can be set up to serve as a master multiple plug gage for testing the center-to-center dimensions between holes and for checking the positions of holes relative to the outer edges of the work by using adjusting or positioning blocks. The location plates are chromium-plated, and are precision made—straight, parallel, and square. They can be assembled end to end, side by side, or end to side.

The locating plates are matched or fastened together by locking clamps and screws. These clamps are so designed that tightening the screws produces a compressive clamping action that prevents any lateral shifting of the plates. Holes in the location plates are uniformly and accurately spaced and will accommodate the drill bushing adapters, by means of which a great variety of bushings can be used. 97



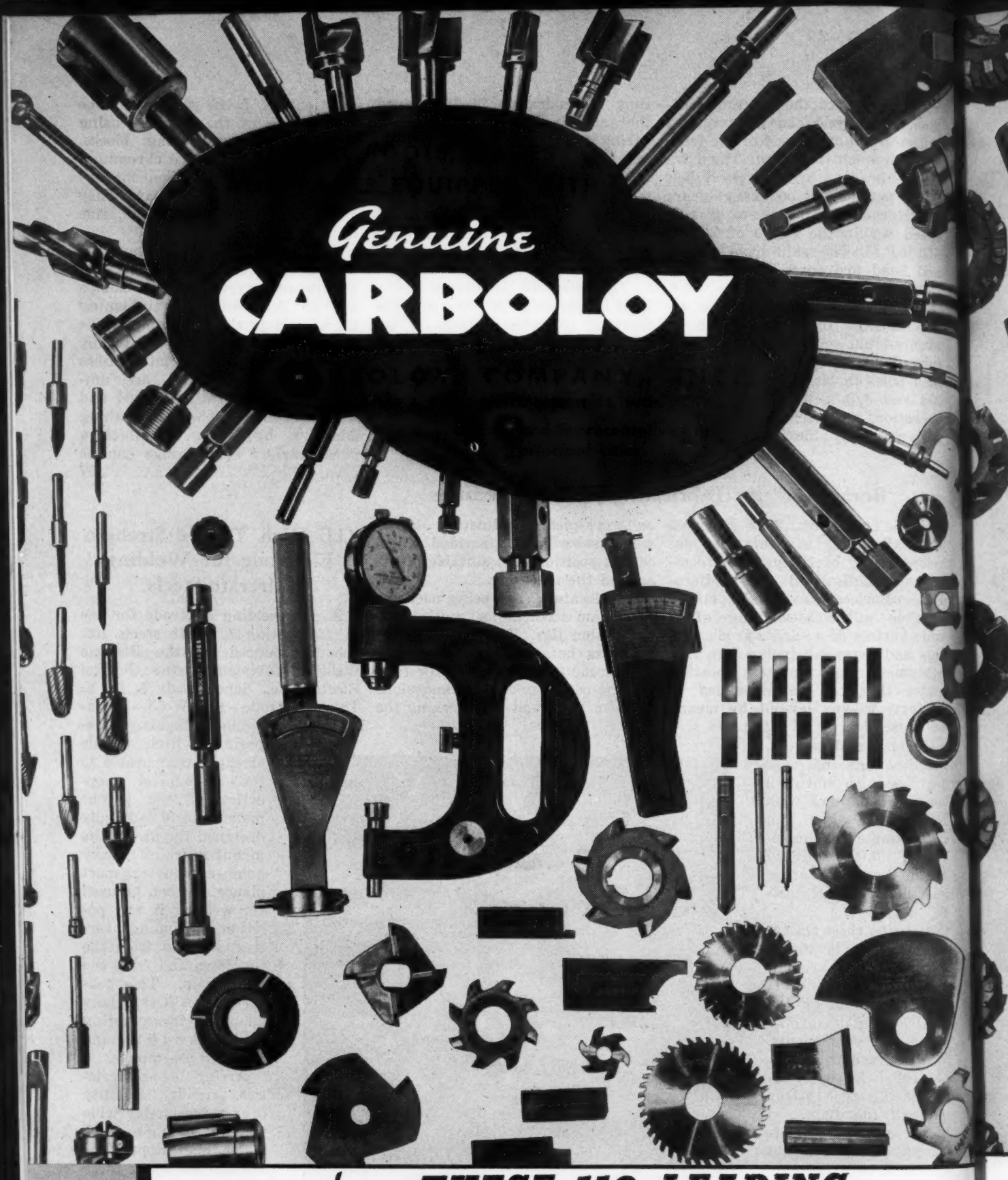
Drill Jig Fabricated from "Micro-King Borlocator" Components

GE High Tensile Strength Electrode for Welding Aircraft Steels

A new welding electrode for use in fabricating aircraft steels has been announced by the Electric Welding Division of the General Electric Co., Schenectady 5, N. Y. This electrode—the W-55—is capable of making a deposit of high tensile strength comparable to the mechanical properties of the parent metal, and is especially designed for use in the manufacture of heavy bombers and transport planes. It can be used for welding in any position, including vertical welding from the top down and from the bottom up. This feature makes it especially adapted for welding engine mounts and fuselage assemblies.

Arcing characteristics provide flexibility over a reasonably wide voltage range with stable operation. The arc has sufficient force to keep from crowding the electrode when welding vertically downward, and the metal sets quickly when welding overhead and vertically upward. The electrode is characterized by its gray ex-

To obtain additional information on equipment described on this page, see lower part of page 204.



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Cleveland Twist Drill Co.	Cleveland
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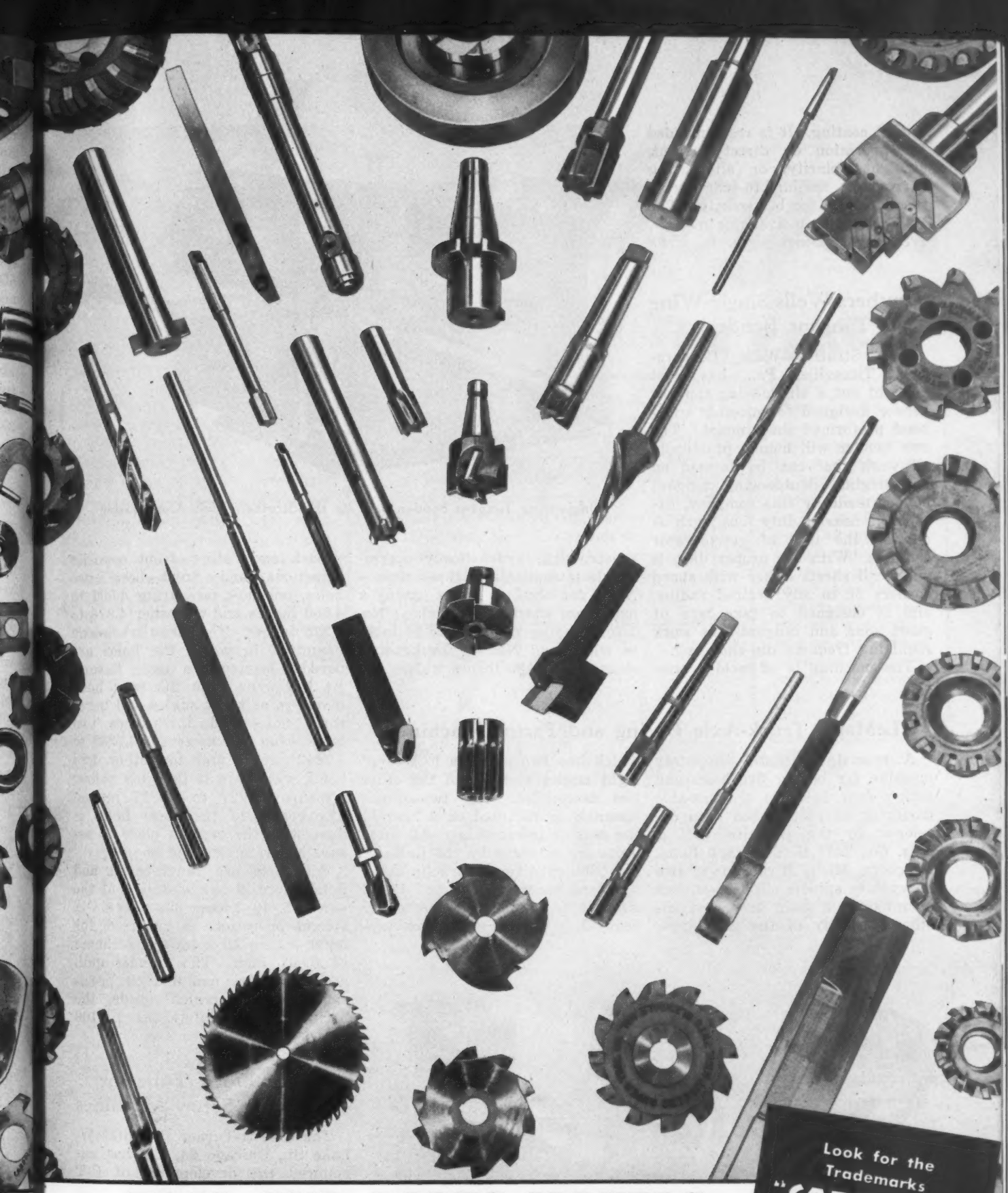
Lake Shore Tool Works, Div. Carbide Tool	Chicago
Lincoln Park Tool & Gage	Lincoln Park, Mich.
Lovejoy Tool Co., Inc.	Springfield, Vt.
Lowell & Grayson Tung-Tip Div.	Moorestown, N. J.



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...England Carbide Tool Co. ... Cambridge, Mass.	Landon P. Smith, Inc. ... Irvington, N. J.	Wesson Co. ... Ferndale, Mich.
...K. Tool Co. ... Shelton, Conn.	Sommer & Maca Corp. ... Chicago	Wetmore Reamer Co. ... Milwaukee
...b Knife Co. ... Cincinnati	Sprague & Henwood, Inc. ... Scranton, Pa.	N. A. Woodworth Co. (Suprex Gage Co.) ... Detroit

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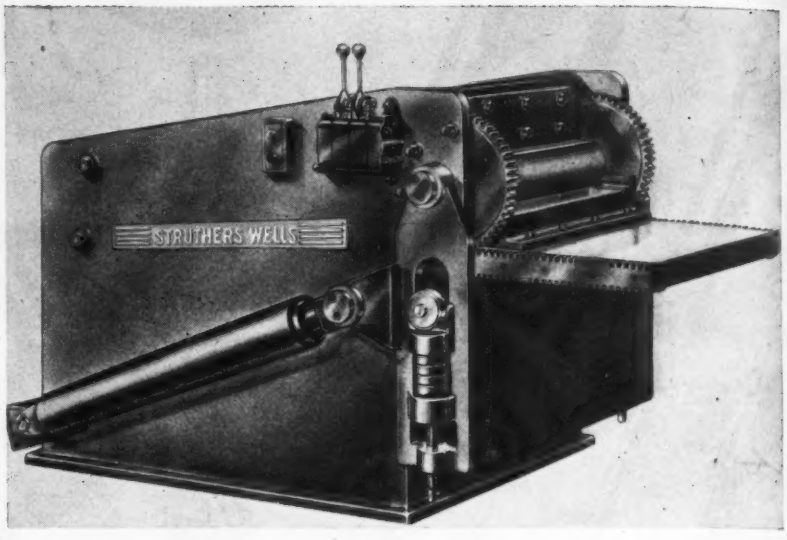
...your assurance that the tools contain genuine Carboloy Cemented Carbide.

truded coating. It is recommended for operation on direct current, straight polarity, or alternating current. A medium to long arc is recommended for best results. The W-55 electrode is available in 3/32-, 1/8- and 5/32-inch sizes.....98

Struthers-Wells Single-Wing Tangent Bender

The Struthers-Wells Corporation, Titusville, Pa., has just brought out a single-wing tangent bender designed to smoothly edge-bend preformed sheet metal. The new bender will handle practically all work that can be formed on the original double-wing tangent bender made by this company, except the heavier duty jobs, such as doming the tops of refrigerator cabinets. With the proper dies, it will bend sheets either with sharp corners or to any desired radius, and is designed to take care of short runs and tangent-bent work requiring frequent die changing.

The machine is of welded steel construction, hydraulically operated. It is available in three sizes—No. 3 for bending sheets having a maximum width of 36 inches; No. 7 for bending sheets up to 84 inches wide; and No. 10 for bending sheets up to 120 inches wide.....99



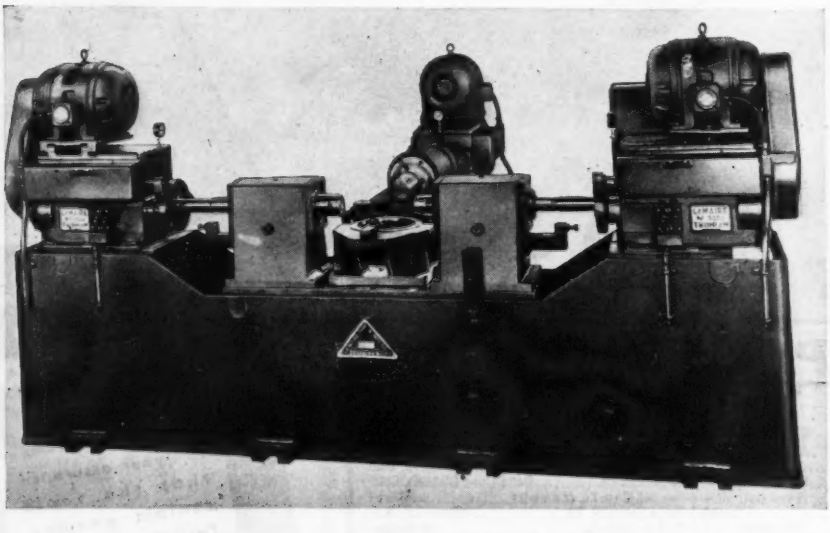
Single-wing Tangent Bender Built by the Struthers-Wells Corporation

LeMaire Truck-Axle Boring and Facing Machine

A special horizontal three-way machine for boring five holes and facing four holes in a truck-axle mounting or carrier has been developed by the LeMaire Tool & Mfg. Co., 2671 S. Telegraph Road, Dearborn, Mich. It consists of two heavy-duty spindle quill assemblies mounted on a main base, and another assembly of the slide type, which has two spindles located at right angles to those of the other two assemblies. The two-spindle assembly is mounted on a base at the rear of the machine. All three units are actuated by the LeMaire No. 5000 twin ram hydraulic units.

In one operating cycle of 1 1/2 minutes, two spindles supported by heavy-duty quill assemblies approach each other from opposite directions and finish-bore two holes, one hole measuring 4.001 to 4.000 inches and the other 4.876 to 4.875 inches. The large truck-axle mounting in which the holes are bored is located in a center fixture. At the same time the rear head moves in at right angles and bores three holes and finish-faces two holes. One hole measures 4.7252 to 4.7242 inches and the other two holes, which are in line just below, measure 4.9227 to 4.9217 inches. The boring of the lower holes is done with the caps in place to assure accurate size and shape.

All parts are rough-bored and finish-faced in one operation at the rate of 40 pieces per hour. A second operation is required for finish-boring all holes to tolerances of 0.001 inch. The spindle quill assemblies are mounted on precision bearings which guide the boring-bars accurately. 100



LeMaire Special Three-way Machine for Boring and Facing Truck-axle Housing

Silent Stock Tube for Automatic Screw Machines

The Corlett-Turner Co., 4011 W. Lake St., Chicago 24, Ill., has announced the development of C-T silent stock tubes for use with automatic screw machines. These tubes, made to replace ordinary stock tubes, are so designed acoustically that they eliminate the banging and clattering noise produced by the bar stock revolving at high speed in the machine. It is claimed that a conversation can be carried on in a normal voice in

To obtain additional information on equipment described on this page, see lower part of page 204.

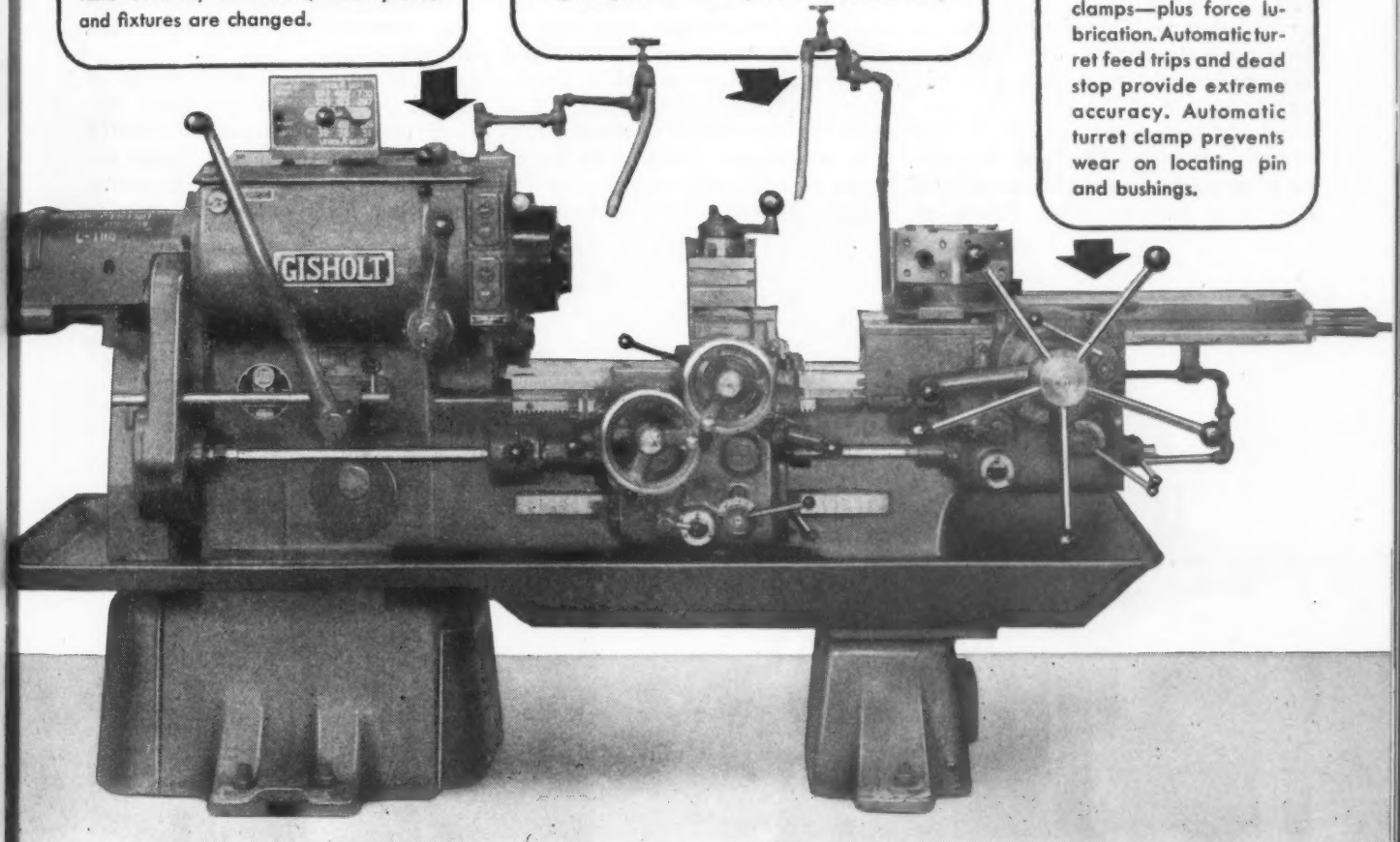
Accuracy...

THROUGH THE YEARS

HERE is where accuracy begins—with bed and headstock cast as one rigid unit that prevents distortion, reduces vibration, provides the foundation for accurate fittings of working parts. Rigid spindle of forged carbon steel, mounted between widely spaced taper roller bearings, assures utmost accuracy and stability. A flanged spindle nose maintains accuracy as chucks, face plates and fixtures are changed.

HERE are hardened steel block type ways, providing a permanent bearing surface not only on top to support the carriages, but also on both sides for exact alignment and beneath for the hold-down gibs and clamps. Force lubrication protects against wear. Large, cross feed dials provide thousandth inch graduations spaced 1/16″ apart, making it quick and easy to obtain accuracy.

HERE is a saddle long enough to give adequate support to the turret ram in any working position. Permanent alignment between turret and spindle is assured by the use of hardened steel ways, tapered gibs and clamps—plus force lubrication. Automatic turret feed trips and dead stop provide extreme accuracy. Automatic turret clamp prevents wear on locating pin and bushings.



GISHOLT accuracy is lasting because it is found in every detail—in workmanship, materials and design. And looking ahead through long years of hard service, Gisholt has provided the means of compensating for inevitable wear to minimize the loss of accuracy. Before you invest in metal turning equipment, be sure you have full information about these new Gisholts.

GISHOLT MACHINE COMPANY • *1209 E. Washington Ave., Madison 3, Wis.*

Look Ahead...Keep Ahead...With Gisholt Improvements in Metal Turning

GISHOLT

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES

closely packed screw machine departments where these silent stock tubes are used, even when machining hexagonal, square, or other noise producing bars. It is also claimed that these installations have decreased absenteeism, as well as work spoilage. ——101

Kindt-Collins All-Purpose Disk Grinder

A disk grinder designed for grinding any type of metal, wood, or plastic material has been developed by the Kindt-Collins Co., 12651 Elmwood Ave., Cleveland 11, Ohio. This grinder is made in two similar models designated regular and heavy duty. The regular-duty model uses cloth or paper abrasive disks, while the heavy-duty model employs a grinding disk.

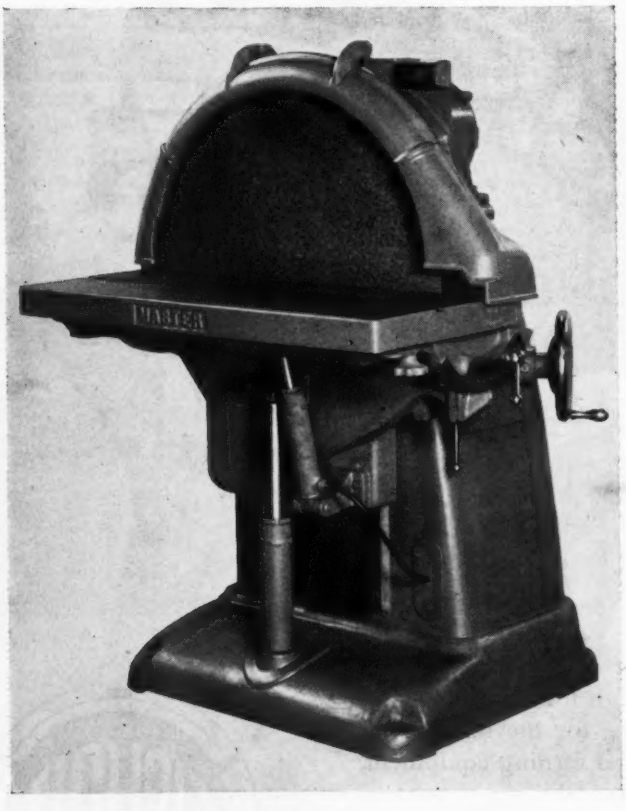
Hydraulic controls serve to eliminate all gears, worms, and jackshafts ordinarily employed for raising, lowering, and tilting the table. An accurate positioning stop provides for stopping the table in any angular position, from 45 degrees below to 15 degrees above the longitudinal position. The table can also be lowered to within 4 inches of the bottom of the disk. The protractor degree marks are large and clearly engraved. The table is vented with perforations that direct the dust into dust guards. Paper or cloth abrasive disks can be replaced without removal of the steel disk. A conveniently located handle operates the hydraulic valve, and a 10-inch handwheel controls every hydraulic operation. Start and stop button control is mounted at eye level on the front of the machine.

The motor is mounted on a hinged pedestal over the shaft and drives the main shaft through three V-belts. The disk speed is 800 R.P.M., which gives a surface or rim speed of 6260 feet per minute. The regular model is equipped with a 3-H.P., ball-bearing, 1150-R.P.M., alternating-current, two- or three-phase motor, while the heavy-duty unit uses a 5-H.P. motor of the same type. The machine requires a floor space of 41 by 38 1/2 inches, and has an over-all height of 57 5/8 inches. The total shipping weight is 2100 pounds.——102

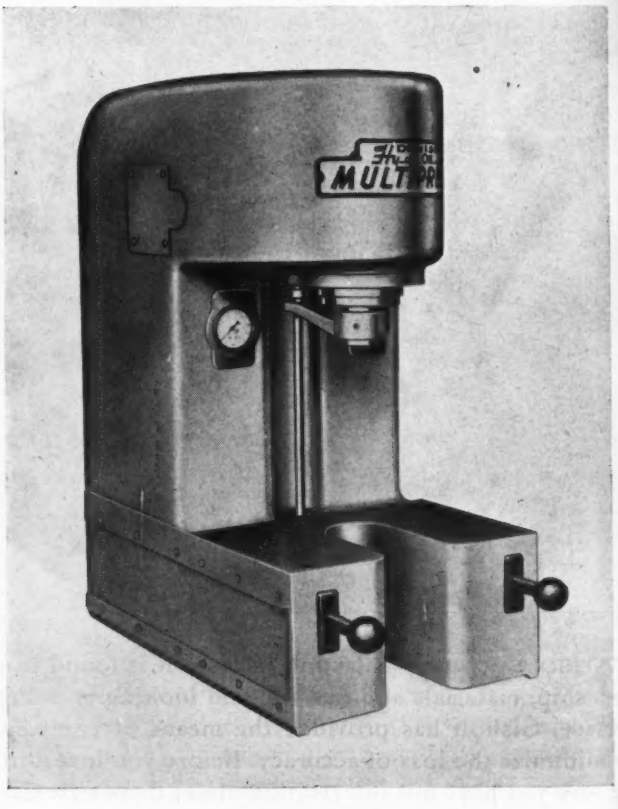
Denison Multi-Purpose Bench Press

A multi-purpose bench press designed to provide an economical means of speeding up operations requiring the application of pressures ranging from 300 to 8000 pounds in single or repeated up-and-down strokes has just been introduced to the trade by the Denison Engineering Co., 1152 Dublin Road, Columbus 16, Ohio. This press is completely self-contained in a streamline housing, 16 by 26 by 34 inches, and weighs only 745 pounds. It will deliver up to 4 tons pressure on the down stroke and up to 5000 pounds pull on the up stroke. Accessories and fixtures are available for performing a great variety of operations, including pelleting, honing, broaching, peening, assembling, burnishing and straightening.

When both the control levers of the basic unit are depressed, the ram moves downward. Releasing either one of the levers causes the ram to stop instantly. Releasing the other lever causes the ram to



All-purpose Disk Grinder Brought out by the Kindt-Collins Co.



Multi-purpose Bench Press Built by the Denison Engineering Co.

To obtain additional information on equipment described on this page, see lower part of page 204.

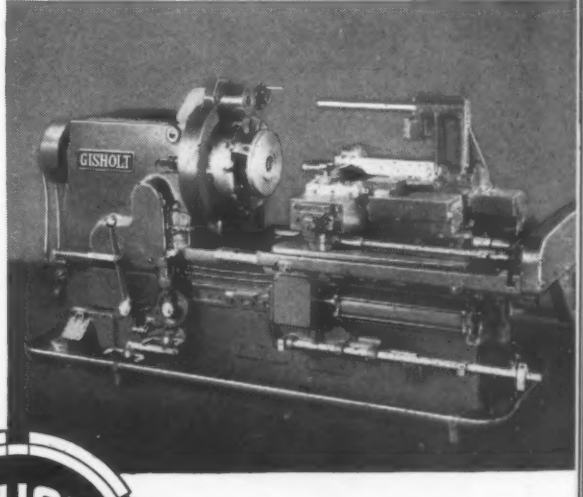
. . . BY THE GISHOLT SIMPLIMATIC

Production cost on one lot cut from $74 to $21.50!

"Thanks to Gisholt Simplimatics," said the manufacturer who reported this impressive saving. On switching to Simplimatic Lathes, he saw the output jump almost 50% . . . costs cut 71%! And the four Simplimatics required only *two* operators where the previous machines took *four!*

Results like this are to be expected where Simplimatics take over. For these rugged, multiple-cutting lathes are designed to provide the extremely high speed so vital to mass production. Since all operations are completely automatic, one operator can tend several machines.

There you have it—high speed, extreme accuracy, simple operation. If these things are important to you, investigate the Gisholt Simplimatic now. A postcard will bring full particulars.



GISHOLT MACHINE COMPANY
1209 East Washington Ave. • Madison 3, Wisconsin

Look Ahead . . . Keep Ahead . . . with Gisholt Improvements in Metal Turning

GISHOLT

GISHOLT SIMPLIMATICS are built in both Platen and Radial types. Both permit a wide variety of tool arrangements, yet neither requires a high degree of skill from the operator.

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES

return to its extreme upper position, where it is positively held stationary. By slowly depressing the hand-levers, the ram can be inched downward and positioned exactly above the work before pressure is applied. Full pressure can then be exerted upon the work at once by completely depressing the levers, or the pressure can be increased gradually by depressing the levers slowly. An eye level gage indicates the pressure applied. Dual controls requiring the use of both hands insure safe operation.

The machine can be preset to deliver any maximum ram pressure from 300 to 8000 pounds, and the ram speed can be regulated between a maximum of 200 inches per minute and a minimum of 20 inches per minute by means of a knurled knob and lock-nut. The table is 16 by 10 1/2 inches, the daylight opening 11 inches, and the throat opening 6 inches. Power is furnished by a 3-H.P. electric motor. Extension tables increase the working surface of the unit to 10 1/2 by 32 inches.

An automatic cycling accessory is available with which a single lever affords the operator his choice of four automatic oil-hydraulic actions designated as "continuous cycle," "single cycle," "hold-down," and "emergency reverse." Another accessory consists of a compact motor-driven indexing table designed for rapid continuous operation. Six stations, indexing accurately under the synchronized ram, can be loaded and unloaded at optional speeds. 103

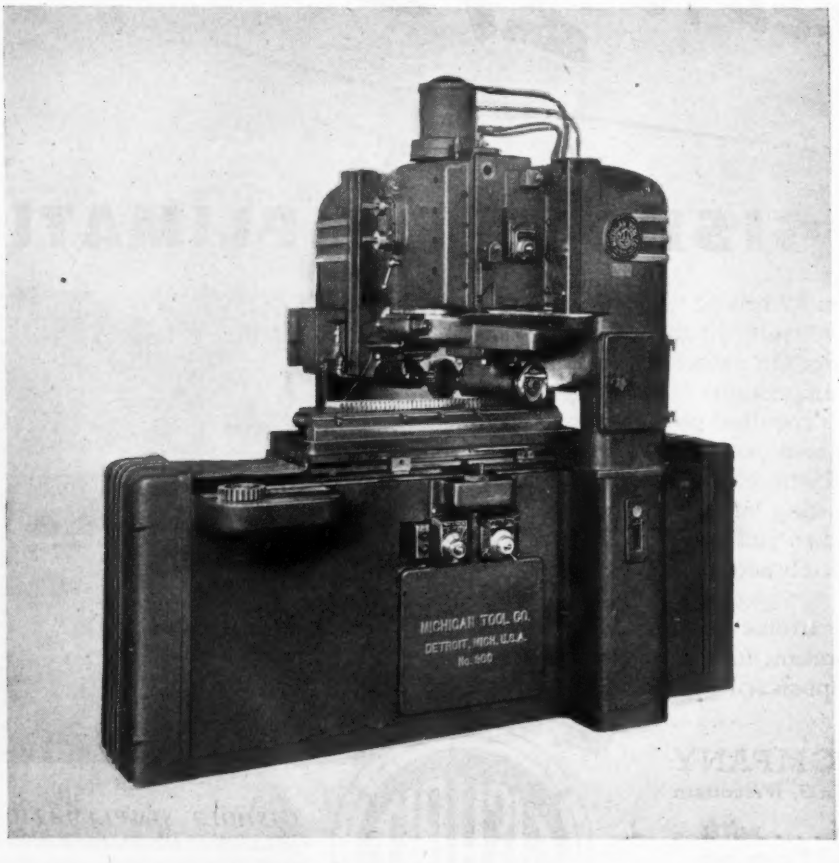
Michigan Improved Gear-Finishing Machine

The Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich., has developed an improved line of Series 900 rack type, crossed-axis, gear-finishing machines designed for complete hydraulic operation. The machines have two separate hydraulic systems, one for the operation of the table and one for the head.

Lubricants and coolants have entirely separate outlets, which reduces the chance of contamination of one by the other and enables coolant coolers to be employed if demanded by extreme conditions. Automatic lubrication has been extended to the rack table ways, which are of hardened and ground dovetail construction instead of the previously used inverted vee design. Improved means for making adjustments for wear of the table ways have also been provided.

The control system has been improved to facilitate holding tolerances to extremely close limits. During the cutting cycle, the work is reciprocated at a predetermined rate of speed across the rack while the rack reciprocates longitudinally in mesh with the work. Controls for both rates of speed can be quickly adjusted. A positive counter is also provided for use in regulating the number of finishing strokes desired after the vertical feed has been completed in order to bring the work to the correct size on the pitch diameter.

The electrical controls have been improved from a safety and durability standpoint, the start and stop button stations operating on 110 volts instead of on the power line voltage. The new Series 900 machines are designed to finish gears up to 8 inches in diameter with a maximum length between centers of 18 1/2 inches. The design permits pre-compensating for possible heat-treatment distortion of the gears subsequent to finishing. Thus, if it is found that a helical gear has a tendency to "unwind" a few tenths or a few thousandths of an inch in heat-treatment, the relationship of the rack and work can be quickly set to pre-compensate for this distortion. 104



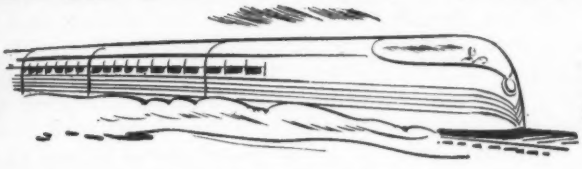
Improved Gear-finishing Machine Brought out by the Michigan Tool Co.

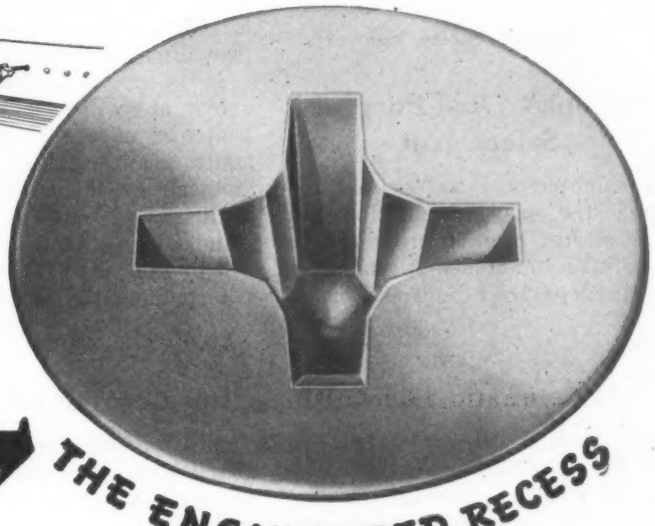
"Eureka" Electrodes

The Welding Equipment & Supply Co., 223 Leib St., Detroit 7, Mich., has recently added two new "Eureka" electrodes to its regular line. One is a molybdenum high-speed steel electrode which produces typical molybdenum high-speed steel weld deposits of 60 to 64 Brinell C hardness, and the other is a hot-work tool-steel electrode which produces carbon molybdenum chromium deposits having extreme hardness and abrasion resistance at high heat with a Rockwell C hardness of 58 to 62. Both of these new electrodes produce "hard-as-welded deposits that can be heat-treated. 105

To obtain additional information on equipment described on this page, see lower part of page 204.

NO "DOCTORED-UP" VERSION OF AN OLD IDEA—IT'S A 20TH CENTURY DESIGN THAT TOOK YEARS OF RESEARCH AND TESTING TO DEVELOP!





IT'S PHILLIPS — THE ENGINEERED RECESS

In ease and speed of driving, there is nothing quite like the Phillips Recessed Head Screw.

That's because the Phillips Recess was developed from scratch–not just adapted from some older, less satisfactory type of recess. It's an *engineered* recess . . . with years of costly testing and research behind each design feature.

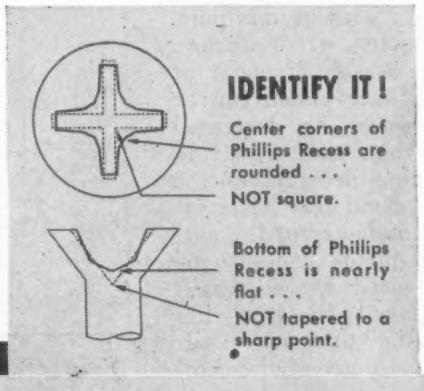
As a result, every angle, every flat plane, every dimension of the Phillips Recess makes a definite contribution to easier, faster, more efficient screw driving.

The recess walls are angled just right to eliminate fumbling starts, to let workers utilize their *full* turning power. The 16 flat planes are provided to hold even worn drivers snugly. And the depth of the recess is exactly figured to give unusual strength to Phillips Screw Heads, and make it easy to keep Phillips Bits and Drivers lined up with the axis of the screw.

To Make Wartime Quotas and Peacetime Profits . . . get the faster starting – faster driving–stronger, better-looking fastenings that only screws with Phillips Recessed Heads can give you! All over the country, manufacturers are switching to Phillips Recessed Head Screws to speed up assembly and cut costs. Give your assembly department "a shot in the arm" – change to Phillips Screws, too. Available in all head styles, types, and sizes!

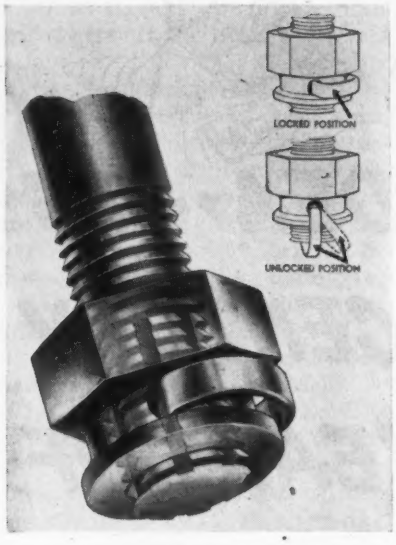
PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS


IDENTIFY IT!
Center corners of Phillips Recess are rounded . . .
NOT square.
Bottom of Phillips Recess is nearly flat . . .
NOT tapered to a sharp point.

24 SOURCES

American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Wolverine Bolt Co., Detroit, Mich.



"Simlok" Safety Nut

"Simlok" Dual-Purpose Safety Nut

A dual-purpose safety nut designed for easy installation and low cost has been brought out by the Simlok Fastener Division of the Simmons Machine Tool Corporation, 1600 N. Broadway, Albany 1, N. Y. The locking action is obtained by the engagement of a snap ring in one of seven longitudinal serrations cut quickly in the bolt thread by a simple internal broaching tool. The seven serrations provide fourteen locking positions per revolution of the nut. The nut can be used on any length thread, being easily locked or unlocked by a flip of the locking ring.

The broaching tool is designed for use in close quarters, and can be hand-operated in the case of preassembled parts. When the safety nut is used as a stop-nut, serrations in the bolt thread are not necessary. After the nut is tightened, the locking ring is snapped into the locked position, the spring pressure providing the stopping action.

It is claimed that the Simlok safety nut will withstand abnormal heat and moisture. It requires no additional torque or wrench pull and can be turned down by hand until seated on the work. Any standard open-end socket wrench will fit the nut. The locking ring is a permanent part of the nut.—106

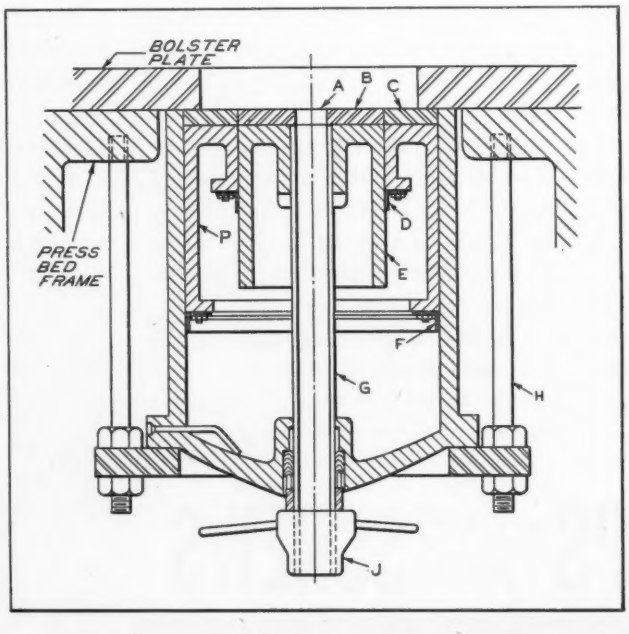
Pneumatic Die Cushion for Compound Dies

The Dayton Rogers Mfg. Co., 2835 Twelfth Avenue., South, Minneapolis 7, Minn., has brought out a Model DC compound pneumatic die cushion designed to provide draw-ring holding pressures required on two independent blank-holders of a compound blanking, piercing, and drawing die. This new die cushion is made in three sizes, the piston *P* being made with maximum diameters of 12, 14, and 16 inches.

The inner piston *E* is made with a minimum diameter of 5 inches. The outside diameter of the inner piston can be increased or decreased to vary the draw-ring holding pressure of the compound die. The inner diameter of the outside piston can also be increased or decreased relative to the draw-ring holding pressure needed on a given die, compensating for a constant air pressure of the pneumatic die-cushion cylinder itself. The hollow stem *A* can be increased or decreased in size to conform with the requirements of a given die, or stem *G* can be replaced by a solid shaft. The hollow shaft *A* has the advantage that it will allow slugs to drop through the cushion unit.

The piston packings *D* and *F* are of standard design. The length of the skirt on the inner piston *E* can be increased or decreased to conform with the requirements of the tool design. The entire cushion unit is supported by four suspension rods *H*, screwed into drilled and tapped holes in the press bed frame, or it can be fastened directly to the punch-press bolster plate. The handwheel *J* provides an adjustment for stopping the inner piston *E* at a predetermined height to compensate for die sharpening.

Although designed to meet the requirements of double- and triple-action dies, this universal die cushion can be used where conventional type pneumatic die-cushion equipment is needed for controlling the single draw-ring. A combination reducing regulator valve and pressure gage automatically maintains a predetermined working pressure on the cushion cylinder unit.—107



Pneumatic Die Cushion for Compound Dies
Made by Dayton Rogers Mfg. Co.

Low-Pressure Hydraulic Valve

The Galland-Henning Mfg. Co., Milwaukee, Wis., has just placed on the market a 3/4-inch three- and four-way operating valve for low-pressure hydraulic service to meet the demand brought about by the constantly increasing use of this size piping in manufacturing plants. This new "Nopak" hand-operated hydraulic valve is designed to provide dependable leakproof service at pressures up to 300 pounds per square inch.

The regular Nopak features, such as the patented cored disk, precision hand-lapped surfaces of disk and seat, line-pressure sealing, and finger-touch control have been embodied in this valve. A stuffing box with gland nut has been incorporated in the design to prevent seepage of hydraulic fluid at the valve stem. The valve is made in all-bronze construction

To obtain additional information on equipment described on this page, see lower part of page 204.

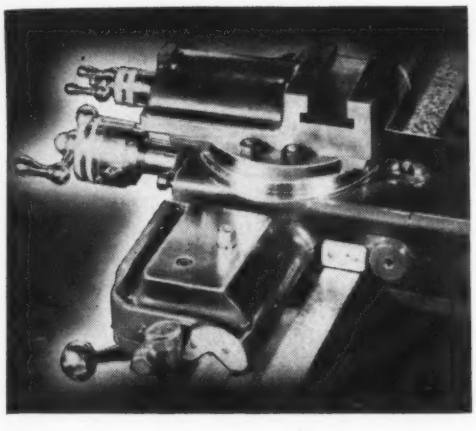
★ WILCOX STEEL CO., Canton, Ohio • FITTSBURGH PLATE GLASS CO., Kokomo, Ind. • QUIMBY PUMP CO., Inc., Bound Brook, N. J. • ILLINOIS STEEL CO., South Chicago, Ill. • SUNNYVALE NAVAL AIR STATION, Mountainview, Calif. • STREINE TOOL & MFG. CO., New Bremen, Ohio • WESTINGHOUSE ELEC. & MFG. CO., East Pittsburgh, Penna. • CURTISS PROPELLER DIV., Caldwell, N. J. • ATLAS METAL STAMPING CO., Philadelphia, Penna. • CURTISS WRIGHT CORP., Buffalo, N. Y. • OMAHA STEEL WORKS, Omaha, Neb. • ALUMINUM CO. OF AMERICA, Clifton, N. J. • WESTINGHOUSE ELEC. & MFG. CO., Philadelphia, Penna. • U. S. ELECTRICAL MOTORS, INC., Los Angeles, Calif. • HOOVER ELECTROCHEMICAL CO., Springfield, Ohio • CONSOLIDATED STEEL CORP., Chicago, Ill. • STEEL PRODUCTS ENGINEERING COMPANY, Warren, Ohio • WESTINGHOUSE ELEC. & MFG. CO., Echota, Tenn. • GENERAL FIRE EXTINGUISHER CO., Indianapolis, Indiana • MUELLER BRASS COMPANY, Port Huron, Mich. • NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS, Oswegatchie, N. Y. • BRIDGEPORT BRASS COMPANY, Bridgeport, Conn. • TOOL & DIE & MFG. CO., Wilmington, Calif. • CHICAGO GREAT WESTERN R.R. COMPANY, Chicago, Ill. • KRAUTER-VOGEL CO., Milwaukee, Wis. • Mallett Field, Calif. • KEMPSMITH MACHINE COMPANY, Milwaukee, Wis. • WILLAMETTE HYSTER CO., Portland, Oregon • CLIFTON ORE CO., Philadelphia, Penna. • PACKARD MOTOR CAR CO., Detroit, Mich. • KANKAKEE COCHRANE CORP., Philadelphia, Penna. • BABCOCK & WILCOX CO., Barberton, Ohio • MONTAUP ELECTRIC CO., Fall River, Mass. • CHRYSLER CORP., Detroit, Mich. • WORTHINGTON FORD BROS., Detroit, Mich. • CRANE CO., Chicago, Ill. • DUPONT DE NEMOURS & COMPANY, Wilmington, Del. • ORDNANCE WORKS, Elwood, Ill. • ERIE R. R. COMPANY, Cleveland, Ohio • WYMAN-GORDON CO., Worcester, Mass. • Buffalo, N. Y. • PUMP & MACHY. CORP., Holyoke, Mass. • WESTERN PACIFIC R. R. CORP., San Francisco, Calif. • EXCEL FDRY. & MACH. CO., Houston, Texas • D. O. JAMES MFG. CO., Chicago, Ill. • SEABOARD AIRLINE RAILWAY CO., Norfolk, Va. • RIVERSIDE PUMPING STATION, Burmeister, Utah • CRAMP SHIPBUILDING CO., Philadelphia, Penna. • BETHLEHEM SHIPBUILDING CORP., Quincy, Mass. • DENISON ENGINEERING CO., Columbus, Ohio • CONCOLEUM, Inc., Kearny, N. J. • WATERTOWN ARSENAL, Watertown, Mass. • OFFICER-IN-CHARGE, Foi Madison, Iowa • DOUGLAS AIRCRAFT CO., Inc., Long Beach, Calif. • Fort Wayne, Ind. • BUREAU OF SHIPS, Washington, D. C. • Fall River, Mass. • ARNOLD, SCHWINN & CO., Chicago, Ill. • Quebec, P. Q. • BROWN & SHARPE MFG. CO., Providence, R. I. • WRIGHT AERONAUTICAL CORP., Paterson, N. J. • DENISON ENGINEERING CO., Columbus, Ohio • Fl. Wayne, Ind. • SOUTHERN PACIFIC COMPANY, Los Angeles, Calif. • Fiscaville, Idaho • HOLABIRD & CO., Inc., New York, N. Y. • UNION PACIFIC R. R. CO., Omaha, Neb. • Both, Maine • GIRARD COLLEGE, Philadelphia, Penna. • BATH IRON WORKS, Bath, Maine • KIDDE CONSTRUCTORS, INC., Port Newark, New Jersey • Philadelphia, Penna. • NAVAL SUPPLY DEPOT, Sewell's Point, Va. • WALTER KIDDE CONSTRUCTORS, INC., Philadelphia, Penna. • BRYANT CHUCKING GRINDER CO., Springfield, Vermont • WEDEMANN & GODKNECHT, Baltimore, Md. • Carry, Penna. • NAVAL SUPPLY DEPOT, Norfolk, Va. • LENS CO., Buffalo, N. Y. • THE PENNSYLVANIA R. R. COMPANY, Philadelphia, Penna. • Revere, Penna. • NAVAL AIR STATION, Hillside, N. J. • SKF INDUSTRIES, INC., Philadelphia, Penna. • CONSOLIDATED AIRCRAFT CORP., San Diego, California • CHUCKING GRINDER CO., Springfield, Vermont • FEDERAL SHIPBLDG. & DRYDOCK CO., Kearny, N. J. • SUPT. DOMINION ARSENAL, Lindsay, Ont. • NATIONAL STEEL MFG. CO., Frankford, Phila., Penna. • HUDSON & IRON CO., Ltd., Hamilton, Ontario • CHICAGO BRIDGE CAR CORP., Hillside, N. J. • NAVY YARD, Brooklyn, N. Y. • PIGEON Ft. Humphreys, Va. • NAVY YARD, Bremerton, Wash. • MAINE ISLAND Camden, N. J. • NAVY YARD, Mare Island, California • SHIPBUILDING CORP., SOUND NAVY YARD, Spokane, Wash. • CHRISTY COMPANY, NAVY YARD, Boston, Mass. • MACHINE COMPANY, MACHINERY CO., Inc., Niagara Falls, N. Y. • GENERAL Fremont, Ohio • CROSS GEAR & MACHINE CO., Chicago, Ill. • ILLINOIS PANAMA CANAL, Cristobal, C. Z. • CHISHOLM RYDER CO. INC., Niagara Falls, N. Y. • CARNEGIE STEEL CORP., Irvin, Penna. • PENNSYLVANIA R. R. CO., Detroit, Delaware • FORD MOTOR CAR COMPANY, Detroit, Mich. • CURTISS-WRIGHT CORP., Columbus Wilmington, Del. • CURTISS-WRIGHT CORP., Columbus, Ohio • COLUMBUS AUTO Little Falls, N. J. • CURTISS-WRIGHT CORP., Chicago, Ill. • CARNEGIE ILLINOIS Windsor, Ont. • CALDWELL CO., Columbus, Ohio • NORTON COMPANY, TOLE VALVE CO., Chicago, Ill. • CALDWELL CO., Inc., New York, N. Y. • Worcester, Mass. • CALDWELL CO., Inc., Niagara Falls, N. Y. • PARTS CO., South Chicago, Ill. • CALDWELL CO., West Newton, Penna. • STEEL CORP., Long Island City, New York • NAVAL U. S. RADIATOR CORPORATION, San Antonio, Texas • WELDMANN MACHINERY BUILDERS, INC., San Diego, Calif. • WORTHINGTON SAN ANTONIO AIR DEPOT, Philadelphia, Penna. • GENERAL ELECTRIC TRAINING STATION, Wallinville, N. Y. • ROOTS CONNERSVILLE MACHINE CO., Anderson, Ind. • ERIE RAILROAD COMPANY, PUMP & MACHINERY CO., Inc., Barrie, N. Y. • WRIGHT MOTORS CORP., Cameisville, Ind. • MOORE STEAM TURBINE CORP., Holyoke, Mass. • BUDD BLOWER CORP., Bloomfield, N. J. • JEBELHOOR BROS., Columbus, Ohio • NAVAL RESERVE COMPANY, N. J. • MOORE STEAM TURBINE CORP., Wellsville, N. Y. • THE JEFFREY MFG. CO., Columbus, Ohio • CHAUNUTE FIELD, Rantoul, Ill. Westhawken, N. J. • THE JEFFREY MFG. CO., Columbus, Ohio • NAVAL RESERVE TIELD, Dayton, Ohio • Fort Riley, Kansas • U. S. NAVY YARD, AIR CORPS, Fort Beach, Calif. • MOORE STEAM TURBINE CORP., Wellsville, N. Y. • POINTE MACHINE TOOL CO., AVIATION BASE, Mass. • LA POINTE MACHINE TOOL COMPANY, Charlestown, Mass. • DAVENPORT MACHINE TOOL CO., Shreveport, La. Hussan, Mass. • THE INFERNO CO., Shreveport, La. • CURTISS-Rochester, N. Y. • NAVY YARD, Norfolk, Va. • CRISSY FIELD, Presidio Caldwell, N. J. • LANGLEY FIELD, Hampton, Va. • WRIGHT CORP., Caldwell, N. J. • INDUCTION HEATING, Inc., Detroit, Mich. • U. S. NAVY YARD, of San Francisco, Calif. • INDUCTION HEATING, New York, N. Y. • Carolina • ARROW METAL BUDD MITCHELL FIELD, New York, N. Y. • STANDARD GAGE CO., Inc., Detroit, Mich. • AIR ASSOCIATES, INCORPORATED, OFFICER, Charleston, South Carolina • WESTERN LAND IMPROVEMENT PRODUCTS CO., Detroit, Mich. • STANDARD GAGE CO., Inc., Detroit, Mich. • KINGSBURY MACHINE COMPANY, Long Beach, Calif. • U. S. NAVAL DRY DOCK, Pougkeepsie, N. Y. • WESTERN LAND IMPROVEMENT Bendix, N. J. • STANDARD GAGE CO., Inc., Detroit, Mich. • KINGSBURY MACHINE WORKS, Philadelphia, Penna. • U. S. NAVAL DRY DOCK, So. Boston, Mass. • ZENITH RADIO CORP., Chicago, Illinois • HAWAIIAN Gary, Indiana • AMERICAN SHEET & TIN PLATE CO., Honolulu, T. H. • JOHN E. MITCHELL CO., SAN ANTONIO AIRSENAL, San Antonio, Texas • GENERAL ELECTRIC CO., Horsey, Ill. ORDNANCE DEPOT, Texas • WESTERN-AUSTIN CO., Aurora, Ill. • NATIONAL SUPPLY COMPANY, Dallas, Texas • PRECISION PRODUCTS, INC., Pittsfield, Mass. • WESTINGHOUSE ELECTRIC & MFG. CO., WESTERN AUSTIN CO., Toledo, Ohio • WESTINGHOUSE ELECTRIC & MFG. CO., Corry, Penna. • HOTCHKISS TOOL & ENGINEERING CO., Lima, Ohio • ASSOCIATED SHIPBUILDERS, Detroit, Michigan • UNION TWIST DRILL CO., Seattle, Wash. • LAKE WASHINGTON Rock Island, Quebec • ASSOCIATED SHIPBUILDERS, SHIPYARD, Houghton, Washington COLUMBIA AIRCRAFT PRODUCTS, INC., Somerville, New Jersey FLANNERY BOLT CO., Bridgeville, Penna. OHIO SEAMLESS TUBE CO. ★

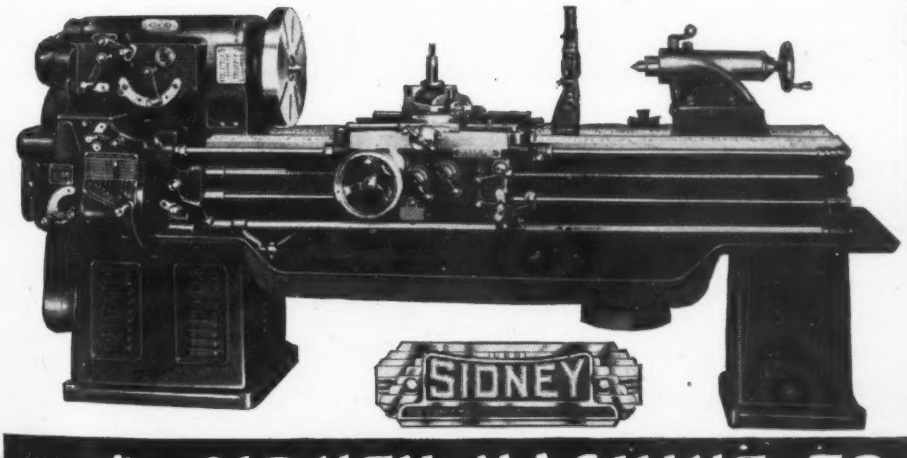
PROMINENT USERS OF

Sidney Lathes

GET FLEXIBILITY WITH COMPOUND REST

The cross feed and compound screws are furnished with adjustable nuts and tapered gibs to compensate for backlash and wear . . . both are equipped with large micrometer dials and provided with ball thrust bearings . . . A micrometer stop on the cross feed provides an adjustable depth stop for turning or threading—and for internal and external thread chasing . . . The swivel of the compound rest is graduated 90° each way from center and is securely held in place by four bolts . . . Note center gib provided in addition to front and rear gibs under V ways . . . Bulletins on each model available.





The SIDNEY MACHINE TOOL Company

Builders of Precision Machinery

SIDNEY ESTABLISHED 1904 OHIO

with lubricating channels in the disk and seat for water-hydraulic service, and in semi-steel without channels for oil-hydraulic service. 108

Republic Shankless High-Speed Twist Drill

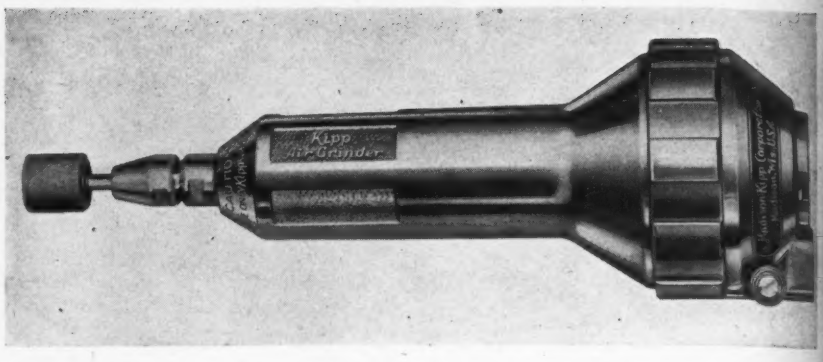
The shankless high-speed drill, shown in Fig. 1, was introduced to the metal-working industries by the Republic Drill & Tool Co., 322 S. Green St., Chicago 7, Ill., at the Metal Congress held recently in Cleveland, Ohio. This new development in twist drills was originated by Raymond R. Rausch, general superintendent of the Ford Motor Co. Although new to the trade, this drill was perfected and adopted at the River Rouge plant of the Ford Motor Co. over six years ago. Since that time hundreds of thousands of these new type drills have been used at the Ford plant.

The continuous flute of this new style high-speed drill is produced by roll-forging and hot-twisting operations. The finished drill is driven by a removable taper shank, known as the drill driver. The drill driver, also shown in Fig. 1, is not a new product, having been widely used for over twenty-five years for driving the smaller sizes of conventional straight-shank drills. A complete line of these drivers will be manufactured and sold by Scully Jones & Co., Chicago, Ill., and J. C. Glenzer Co., Detroit, Mich., through their established distributors.

The advantages claimed for the new shankless high-speed roll-forged drill include lower manufacturing cost, resulting in reductions of 20 to 30 per cent in the selling price; usable portion of the flutes increased from 25 to 40 per cent; tougher and stronger because it is roll forged and because it has a heavier web than conventional type drills; and neck or driver end of drill toughened by heat-treatment designed to permit it to give slightly under severe torsional strain, and thus serve as a shock absorber to reduce drill breakage.

This new shankless drill is made in 135 sizes ranging from 1/4 inch to 2 inches in diameter. Only seven sizes of drill drivers, ranging from No. 1 to No. 5 Morse taper are required for driving the 135 different sizes of drills.

The "All-Flute" straight-shank drill, shown in a standard drill chuck in Fig. 2, was also introduced by the Republic Drill & Tool Co. at the Cleveland show. It is similar to the shankless drill, being produced by the same roll-forging and hot-twisting process. This drill is available in sizes ranging from 1/4 to 1/2 inch in diameter. It can be held in all standard drill chucks without the use of special holders of any kind. The straight-shank end of the "All-Flute" drill is produced by giving the shank end of the flute section an extra twist, which causes the spiral flutes to be compressed so the shank can be gripped firmly in the chuck. 109



Light-weight Air Grinder Brought out by the Madison-Kipp Corporation

Madison-Kipp Light-Weight Air Grinder

A feather-weight Model JA hand grinder of a completely new design is being introduced to the trade by the Madison-Kipp Corporation, 203 Waubesa St., Madison 4, Wis. The speed of the standard model is 50,000 R.P.M., although even higher speeds can be made available when absolutely necessary and when the operation can be carefully supervised. The grinder consists of only twenty-three parts, including such minor items as nameplate and drive screws. It has an over-all length of 6 1/2 inches and weighs 12 ounces, the extremely light weight being obtained by the use of aluminum and magnesium parts. Kipp mounted grinding wheels, cutters, and other accessories having shanks 1/8 inch in diameter can be used with this grinder.

The shaft of this new model is made from round alloy-steel bars 9/16 inch in diameter ground to 0.547 inch in diameter, which is an increase of 0.232 inch over the shafts used in previous models. The shaft is mounted on two special high-speed New Departure

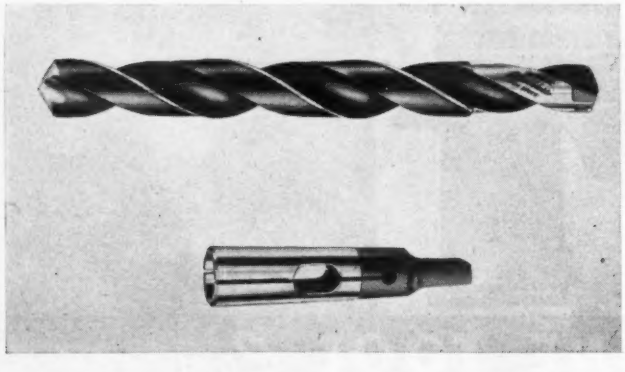


Fig. 1. Shankless Drill Recently Placed on the Market by Republic Drill & Tool Co.

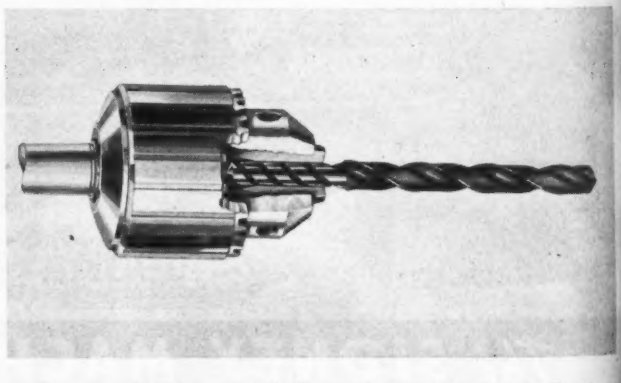


Fig. 2. "All-Flute" High-speed Straight-shank Drill Shown in Standard Chuck

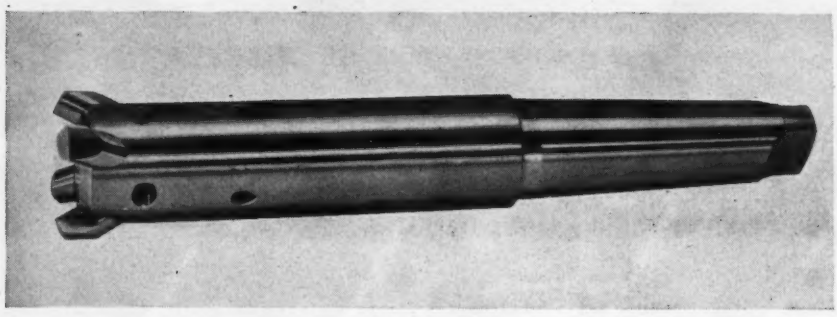
To obtain additional information on equipment described on this page, see lower part of page 204.

LAKE ERIE Hydraulic Presses should be investigated by executives concerned with metal blanking, forming, drawing or coining. They are adaptable to every operation from deep drawing of large parts down to shallow forming of small pieces. Our long and varied experience in designing and building Hydraulic Presses will effect substantial savings in your operation.

LAKE ERIE ENGINEERING CORP., BUFFALO 17, NEW YORK

District Representatives: 250 Park Avenue, New York 17, N. Y.; 230 N. Michigan Avenue, Chicago 1, Illinois; Harron, Rickard & McCone, San Francisco and Los Angeles, California; Buck and Hickman, London, England.

PACEMAKER FOR PRODUCTION SCHEDULES



Four-cutter Adjustable Core Drill Made by State Mfg. & Construction Co.

ball bearings with Formica retainers. The large size of the shaft tends to increase the stability of the grinder and promote smoother running, which, in turn, increases the grinder efficiency and lengthens the life of the grinding wheel. The speed of the grinder is closely controlled by a new sleeve type governor.

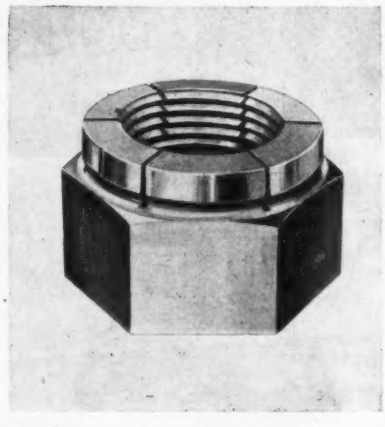
The grinder will operate on air pressures of from 30 to 120 pounds, but ideal results are obtained from the usual shop air pressures of 80 to 90 pounds. Air-hose, wheel guard, wrenches, oil, four assorted grinding wheels, and a dressing stone are supplied with each grinder. 110

Four-Cutter Boring, Reaming, and Core-Drilling Tools

The new four-cutter boring, reaming, and core-drilling tools made by the State Mfg. & Construction Co., Franklin, Ohio, are fitted with bits that are inserted at a 30-degree angle with the axis of the tool body, as shown in the illustration. The inner end of each bit is in contact with a finely threaded screw, by means of which it can be adjusted outward for regrinding or for machining a hole of larger diameter. After adjustment, the bits are clamped securely in position by individual setscrews. Four cutters are normally used for hogging, counterboring, finish-drilling, and reaming.

These tools are built in a variety of sizes, with fluted or plain bodies, and range in cutting diameters from 3/4 inch to 4 3/4 inches. The clusters of bits can be expanded in circumference from 1/8 inch in the smallest model to 1 1/4 inches in the largest for increasing the cutting diameters.

The company also makes special models to meet customers' requirements. These include duplex heads for cutting two or more diameters, pilots, collars, facing bits, wear strips, center oil-holes, etc. 111



"Flexloc" Combination Stop- and Lock-nut

"Flexloc" Lock-Nut

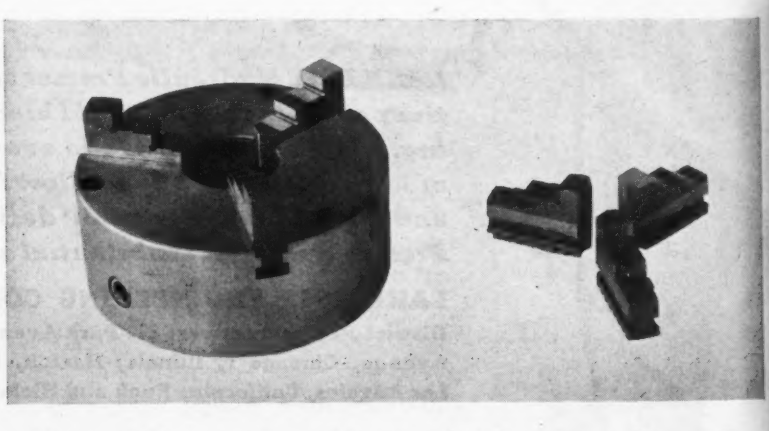
The Standard Pressed Steel Co., Box 22, Jenkintown, Pa., is placing on the market the "Flexloc" lock-nut shown in the accompanying illustration, which previously has been available for Army ordnance and aircraft work only. This nut is made in one solid piece from top to face, so that even the locking threads carry their full share of the load. In addition to being a lock-nut, the Flexloc serves as a stop-nut, since it resists backing off when seated and cannot be shaken loose, regardless of its position on a bolt or threaded bar. It can be used over and over again without losing its ability to lock.

The top of the Flexloc has six radial slots, which provide an equal number of sections that do the actual locking. These lock-nuts are made in National Coarse Thread sizes ranging from No. 6-32 up to 1 inch diameter, 8 threads per inch, and in National Fine Thread sizes from No. 6-40 up to 1 inch diameter, 14 threads per inch. 112

Ideal Universal Chuck

The Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill., has announced the development of a new universal three-jaw chuck designed to supplement its line of machine tool accessories and to meet the demand for a quality chuck at low cost. The body of the chuck is of high-grade, fine-grain, high tensile strength semi-steel. The rib construction has been designed to provide ample resistance to shock, load, and high stresses.

Special tooling has been employed to machine the threads of the scroll as accurately as possible. The scroll is made of alloy steel, and is proportioned to assure true turning and long life. Two sets of jaws are furnished with the chuck, one for internal and the other for external work. The jaws are made of specially treated alloy steel to provide toughness and strength. If one jaw



Universal Three-jaw Chuck Made by Ideal Commutator Dresser Co.

To obtain additional information on equipment described on this page, see lower part of page 20

DOES A *Good Turn* ON 1045 STEEL

SUNOCO
EMULSIFYING CUTTING OIL
helps rough turn 18⅝" spindle head at 265 S.F.P.M.

A good rule when you want a good turn is to use the right cutting oil. That's why so many leading metalworking shops rely on Sunoco Emulsifying Cutting Oil for all operations where a soluble oil can be used.

Just one example is the operation shown, where a large machine tool manufacturer uses a 20 to 1 mixture for rough turning the head end of a large spindle made of S.A.E. 1045 steel. Sunoco meets all requirements of tool life, tolerance, finish and speed. Sunoco's advantages can be applied shopwide, too . . . not only on turning operations, but for milling, boring, drilling, hobbing, slotting, grinding, etc. The high heat-absorbing and lubricating properties of Sunoco Emulsifying Cutting Oil aid in the prevention of overheating and drawing of the temper at the cutting edge. Chips do not seize . . . tools cut cleanly, evenly, at high surface speeds.

In the reconversion period, just as during peak war production, metalworking plants will depend on Sunoco to give them maximum machining efficiency . . . with utmost economy. Now is the time to consider Sunoco Emulsifying Cutting Oil for your plant. Get the recommendations of a Sun Cutting Oil Engineer. Write...

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PERFORMANCE DATA

OPERATION—Turn head end of spindle
MACHINE—Bullard 36" Vertical Turret Lathe
MATERIAL—S.A.E. 1045 Steel Forging
ROUGH TURN—18⅝" diameter
SPINDLE SPEED—54 R.P.M.
CUTTING SPEED—265 S.F.P.M.
FEED—.018"
DEPTH OF CUT—5/16"
CUTTING LUBRICANT—1 part Sunoco to 20 parts water

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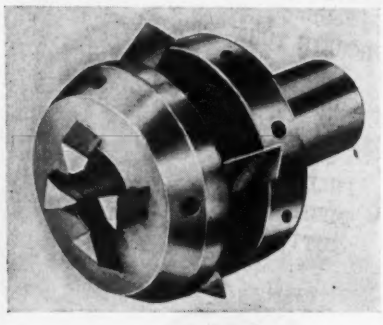
is damaged, it can be readily replaced. This chuck is available at present in the 5-inch size only. A mounting adapter is furnished with each chuck which can be accurately fitted to the particular lathe on which it is to be used.....113

Hollow-Mills with "Tri-Bit" Blades

"Tri-Bit" cutter blades, manufactured by Weddell Tools, Inc., 1239 University Ave., Rochester 7,

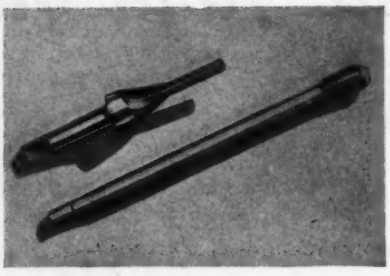


Weddell Hollow-mill with "Tri-Bit" Blades

N. Y., are now being applied to a line of hollow-mills brought out by this company. The triangular tool bits fit into angular-shaped holes in a hollow-mill cutter body, each bit being locked or unlocked by a single screw. The blades are backed up by single adjusting screws or all blades can be simultaneously adjusted by a single nut. "Tri-Bit" hollow-mills are furnished with standard blades of high-speed steel, cast alloys, or carbide tip. They can be obtained with a solid shank, in a shell type, with special piloting bodies, or arranged to accommodate drills or reamers. 114

Gay-Lee Form-Ground Cutting Tools

The Gay-Lee Co., 117 E. Hazelhurst, Ferndale 20, Mich., has brought out a complete line of cutting tools which are form-ground with cam type relief. This line includes standard gear tooth pointers and special tools ranging in size from 1 1/2 inches in diameter down to the very small special reamer shown in the accompanying illustration. This new line includes gear rounding and chamfering cut-

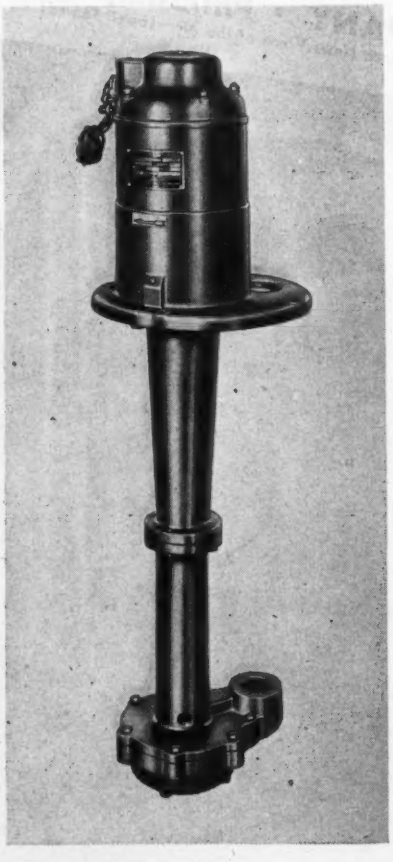


Gay-Lee Special Reamer Shown beside Ordinary Matchstick to Indicate Small Size

ters and clutch-tooth milling cutters, which are made to exceptionally close tolerances. 115

Ruthman Improved Gusher Pump

Compact, efficient motor design, improved balancing methods, and accurate workmanship characterize the improved gusher model HL-15025-B deep-immersion type coolant pump recently brought out by the Ruthman Machinery Co., 1823 Reading Road, Cincinnati 2, Ohio.



Ruthman Gusher Pump Available in Two Immersion Lengths

This pump is available in two lengths for immersion depths of 19 and 23 inches below the high-level line of the coolant reservoir. The mounting bracket is of the circular flange type, 10 1/2 inches in diameter, and is simple to install.

The entire rotating assembly is on a one-piece extended steel shaft, electronically balanced after assembly and mounted in the motor on precision ball bearings. Each unit, after final assembly, is thoroughly tested to insure vibrationless trouble-free operation. Like previous models, this gusher pump has no packing glands or metal-to-metal contact below the high-level line. It is available with a 1/4-H.P. motor for continuous duty and with a 1/2-H.P. motor for extra heavy duty.....116

Improved Dividing Head Brought out by Ellis-Lawyer Tool Co.

Ellis Improved Dividing Head

An improved model double-swivel dividing head formerly known as the "Republic" has been brought out by the Ellis-Lawyer Tool Co., 1001 S. Fremont Ave., Alhambra, Calif. The general construction of this dividing head has been strengthened to permit handling extremely close-tolerance work. It has a ground worm, is provided with hold-down bolts, and is furnished with an extra blank indexing plate which can be drilled to suit special operations.

The head has a 6 1/2- to 11-inch capacity swing and a standard 1 3/4-inch, eight-thread spindle ground to a No. 9 B&S taper. The base is calibrated in degrees, and three index-plates are furnished which permit indexing all numbers

To obtain additional information on equipment described on this page, see lower part of page 204.

MULTIPLE SPLINE PROCESSING

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Dual Lead
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NUTS NOW
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BROACH RE-SHARPENING

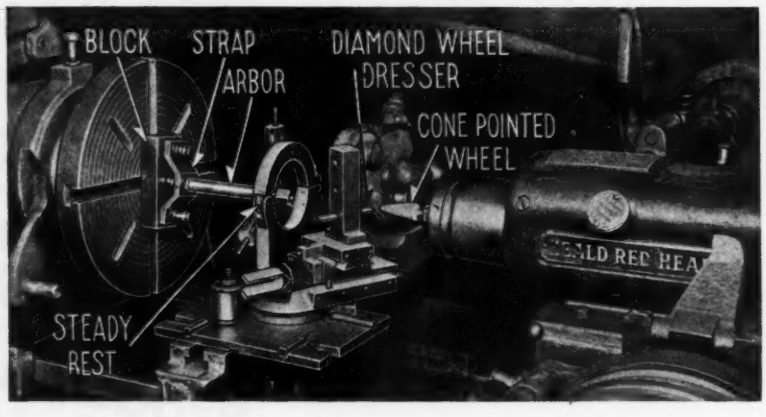
up to 50, even numbers with the exception of 96, multiples of 5 up to 100, and many other numbers up to 1000 and over. Provision is made for a complete revolution of the head in the horizontal plane, and tilting to an angle of 100 degrees to the right and 60 degrees to the left in the vertical plane.

Free-wheeling is instantly obtainable without dismantling, and the worm-gear can be adjusted to eliminate backlash. Assembly equipment furnished with the head includes riser blocks, index-plates, tailstock center with driver arm, standard and double-swivel bases, and hold-down bolts. 117

Regrinding Lathe Arbor Centers

By H. SEBOLT, Tool Design and Manufacture
Westinghouse Electric & Mfg. Co., East Springfield, Mass.

On a national defense job where more than four hundred 0.6285-inch lathe arbors were in constant use twenty-four hours a day on very close tolerance work, it became necessary to find some method of refinishing the worn centers to restore their original accuracy. This was accomplished by a method suggested by the tool grinder, Thomas J. Lynch. A simple steadyrest and clamping fixture, mounted on an internal grinder in the manner shown in the illustration, comprised all the equipment needed for the salvaging work.



Set-up for Regrinding Worn Centers in Lathe Arbors

A block with a 60-degree center was mounted on the faceplate of the grinder, a suitable strap clamping device being used for holding and driving the arbor. The arbor is mounted on the center in this block with the other end held in a steadyrest which was made especially for the internal grinder. The grinding is done with a quill type wheel of 3880-H grade, mounted in the grinding head. Dressing of the wheel is accomplished with a Vinco type diamond dresser.

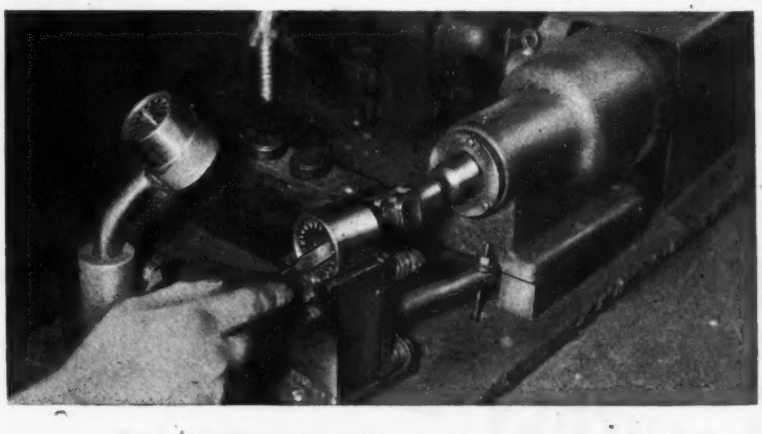
With the work mounted in the steadyrest and the wheel dressed to a 60-degree angle, the machine is operated in the conventional manner. Care is taken not to force the cutting action of the sharp point of the wheel, which should be adjusted to cut only on one side of the center. The fixture illustrated has been used on arbors of several different sizes, and can be adapted to numerous tool-grinding jobs requiring operations of a similar nature. Over eight hundred arbors have been reground in the manner described. The saving in valuable tool hours, together with the ability to get the tools back on the job without delay, has made this a very worthwhile development.

* * *

Special Filing Machine for Small Motor Stator Cores

In the manufacture of small instrument type motors, slots in the stator cores are filed to remove burrs in order to facilitate winding. The file must be so designed that any danger of scoring the bottom of the slots will be eliminated, since scratches on this surface would be detrimental to the magnetic properties of the core. A special filing machine was developed by Joseph Geenens, an assistant general foreman at a General Electric plant, for this purpose. This machine has resulted in a large saving in time and production costs by eliminating hand-filing.

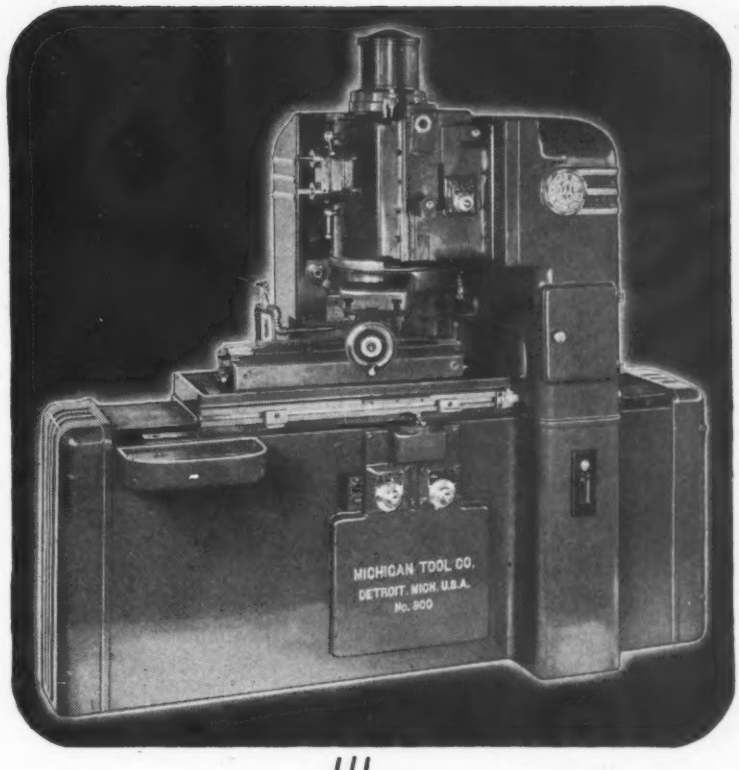
A tailstock assembly from a winding machine, a small motor with speed reducer, a holding fixture, and a file make up the unit. The motor is arranged to impart a reciprocating motion to the file, which is attached to the center shaft and guided by a slot in the fixture. The core is held by spring pressure in the fixture, and the file can be held in the core slot either by hand or spring pressure. A stop is provided to indicate when the slot-filing operation is completed and to prevent interference with the bottom of the slot.



Removing Burrs from Slots in Stator Cores with Special Motor-driven Filing Machine

To obtain additional information on equipment described on this page, see lower part of page 204.

THE 4 FREEDOMS OF GEAR FINISHING



1. FREEDOM FROM INACCURACIES

The Michigan 900, uses the basic "rack" to generate gear teeth. It is the most accurate gear finishing machine ever developed. The best proof of this is the inherent quietness of rack-finished gears.

2. FREEDOM FROM DISTORTION

Gear Finishing on a Michigan 900 is a free-cutting and *not* a cold-working process. The machine can also be set to pre-compensate for heat-treat distortion.

3. FREEDOM FROM SHUT-DOWNS

The Michigan 900 Rack Shaving Machine is one of the few machine tools in the world that will machine up to 100,000 units before sharpening tools.

4. FREEDOM FROM COST

The Michigan 900 represents the lowest-cost-per-gear method of gear finishing. Well over 1,000,000 gears have been finished with a single rack. Can be operated by relatively unskilled labor.

For "Post-war", a number of important improvements have now been added to the Michigan 900—the machine that has never been licked.

Ask for a copy of Michigan Tool Company's Gear Finishing Manual (No. GF-43)

ORIGINATORS of GEAR-SHAVING

MICHIGAN TOOL COMPANY

7171 E. McNICHOLS ROAD . . DETROIT 12, U. S. A.

News of the Industry

California

OMER L. WOODSON has been appointed vice-president and general manager of the Ryan Aeronautical Co., San Diego, Calif. For the last five years he has been vice-president of the Bell Aircraft Corporation, and since 1942, general manager of its Marietta, Ga., plant.

G. C. (JERRY) RASEY has been named supervisor of the Marine and Stationary Diesel Division of the general sales department at the Joshua Hendy Iron Works, Sunnyvale, Calif., with LAWRENCE H. EARLE and LOUIS KAISER as his assistants.

CHICAGO-LATROBE TWIST DRILL WORKS, 411 W. Ontario St., Chicago 10, Ill., have opened a branch warehouse and sales office at 2043 Santa Fe Ave., Los Angeles 21, Calif., under the supervision of J. C. MALUGEN, district representative.

William F. B. Henderson, Vice-president and General Manager, Clearing Machine Corporation

KENNAMETAL, INC., Latrobe, Pa., announces the removal of its Detroit branch to larger offices at 5531 Woodward Avenue. BENNETT BURGOON, JR., for several years Kennametal representative at Rockford, Ill., has been made district manager at Detroit.

M. J. SANDLING, formerly vice-president and sales manager of the Howell Electric Motors Co., will represent the Reliance Electric & Engineering Co., Cleveland, Ohio, in western Michigan, with headquarters in the Pythian Bldg., Kalamazoo, Mich.

L. V. NAGLE has been appointed vice-president in charge of national sales for the Udylite Corporation, Detroit, Mich. Mr. Nagle has been Michigan sales manager for the corporation for the last thirteen years.

THOMAS M. THORNTON has been appointed field engineer in the Detroit territory by the Norton Co., Worcester, Mass.

Illinois and Indiana

SHELDON MACHINE CO., INC., 4240 N. Knox Ave., Chicago, Ill. builder of precision lathes and arbor presses, has acquired the Vernon line of milling machines, jig borers, shapers, and tool grinders heretofore built and sold by the Machinery Mfg. Co. of Los Angeles, Calif. The manufacture of this line of machine tools has been transferred to the Sheldon plant in Chicago.

RUSSELL S. MANN and BENNETT A. WILLIAMS, formerly engaged in the tool and die business, have recently formed the GRINDING SUPPLY CO., with offices located in the Chicago Daily News Bldg., Chicago, Ill. They will handle grinding supplies, wheels, diamonds, chucks, dressers, etc.

GEORGE GREEN has been appointed vice-president in charge of sales of the Mount Vernon Car Mfg. Co., Mount Vernon, Ill., a division of the H. K. Porter Co., Inc., Pittsburgh, Pa. For the last year, Mr. Green has served as railway sales manager of the Elastic Stop Nut Corporation.

JOSEPH G. MAGRATH has been appointed manager of the Chicago Sales district of American Machine and Metals, Inc., East Moline, Ill., with headquarters at 310 S. Michigan Ave., Chicago.

WILLIAM F. B. HENDERSON, formerly general manager of the Plumbing Ware Division and director of service of the Briggs Mfg. Co., Detroit, Mich., has been appointed vice-president and general manager of the Clearing Machine Corporation, Chicago, Ill.

LYON METAL PRODUCTS, INC., Aurora, Ill., announces that the manufacture of steel blueprint cabinets for industrial use, which was stopped because of war conditions, has been resumed, and two sizes of these steel cabinets are now available.

ARTHUR P. EMMERT, formerly vice-president in charge of manufacturing, has been made president of the Warner Gear Division, Muncie, Ind., of the Borg-Warner Corporation. Mr. Emmert succeeds C. S. DAVIS, who has been the head of the Warner Gear Division since 1932, but who has retired from the presidency of the Division in order to give all his time to the Borg-Warner Corporation in Chicago.

Michigan

BURLEIGH-STOCKER MACHINERY CO., 1014 Fisher Bldg., Detroit 2, Mich., has been formed by D. Blair Burleigh, who is president of the organization. Mr. Burleigh was formerly vice-president of the John E. Livingstone Co., Detroit. The new organization represents among others, the following companies: SUNDSTRAND MACHINE TOOL CO., AMERICAN BROACH & MACHINE CO., SOMMER & ADAMS CO., and LEMAIRE TOOL & MFG. CO.

New England

TAFT-PEIRCE MFG. CO., Woonsocket, R. I., has acquired from the J. & H. ELECTRIC CO., Providence, R. I., the rights, title, and interest in the D. & W. magnetic chucks and the J. & H. demagnetizers. These products will be incorporated into the Taft-Peirce line of "Superpower" magnetic chucks and demagnetizers. The Taft-Peirce organization will also service J. & H. Electric Co.'s equipment now in operation.

R. H. LANGDON has been appointed abrasive engineer for the Norton Co., Worcester, Mass., in the district comprising Vermont, New Hampshire, western and southern Massachusetts, and Rhode Island.

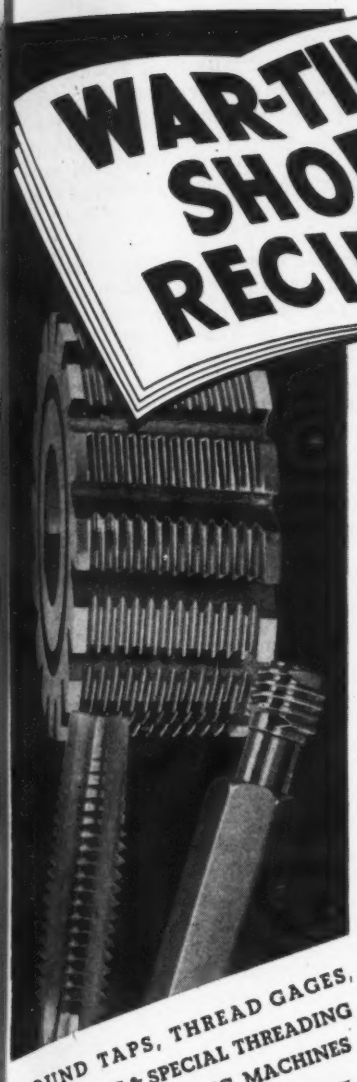
JAMES N. DAVIES, formerly chief tool designer of the Towmotor Corporation, Cleveland, Ohio, has joined the Giebel Machine Tool Co.'s New Haven office as a sales engineer.

New Jersey

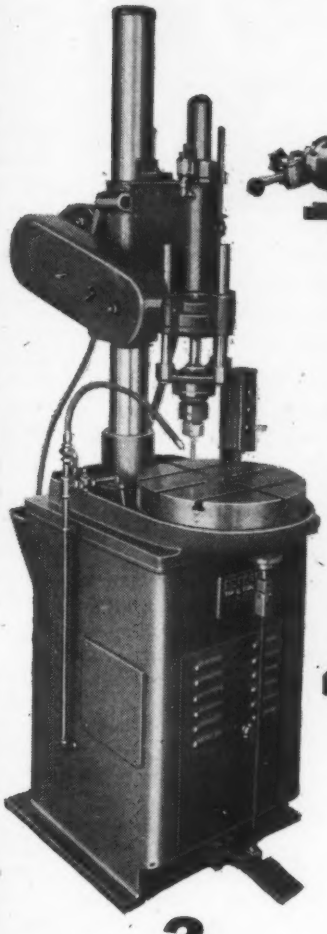
FRED H. COLVIN, Point Pleasant, N. J., has received the honorary degree of mechanical engineer from the Stevens Institute of Technology. He was the first editor of MACHINERY, and later was for thirty-two years one of the editors of the *American Machinist*. Mr. Colvin is also, in collaboration with F. A. Stanley, the author of the "American Machinist's Handbook."

WAR-TIME SHOP RECIPES

4 WAYS TO CUT BETTER THREADS

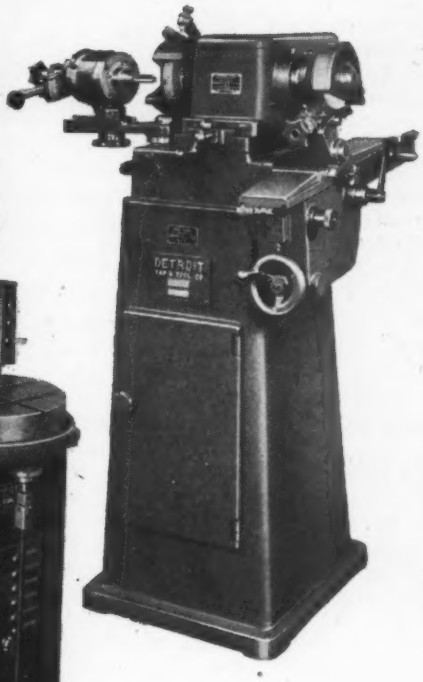


GROUND TAPS, THREAD GAGES, THREAD HOBS & SPECIAL THREADING TOOLS, SPECIAL TAPPING MACHINES



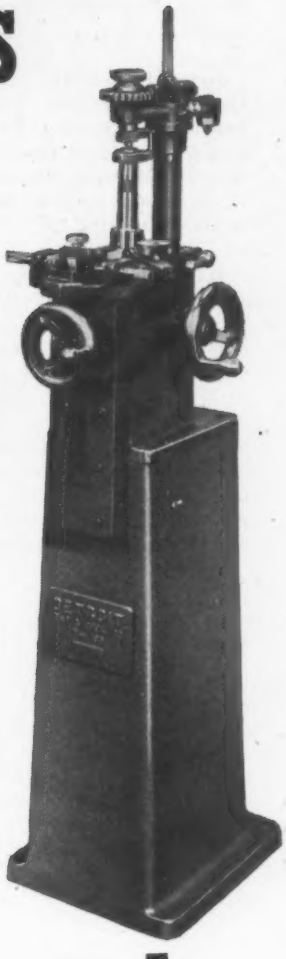
3

Use a "Detroit" Lead Screw Type Tapping Machine
(Light Duty Type Shown)
Ask for Bulletin LTM-44



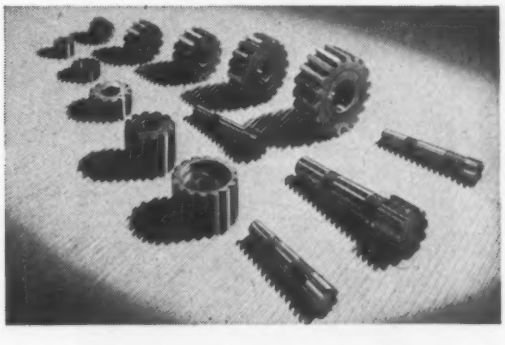
2

Sharpen your taps on the "Detroit" 4 in 1 Tap Reconditioner
Ask for Bulletin DTR-3



1

Check your Thread Milling Cutters on the "Detroit" Hook & Spacing Checker
Ask for Bulletin HC-43



4

Specify Thread Milling Cutters ground from STANDARD Blanks carried in Stock
Ask for Bulletin CB-43

BUY U.S. BONDS STAMPS

DETROIT TAP & TOOL CO.

8432 BUTLER
DETROIT 11,
MICH., U.S.A.

FREDERICK JOHN KNACK, aircraft engineer and designer, has been made vice-president in charge of engineering of the Luscombe Airplane Corporation, Trenton, N. J. Until recently he was with the Fairchild Aircraft Division of the Fairchild Engine & Airplane Corporation.

JOHN J. BOGNAR, formerly chief of the Finishing and Treating Section, Service Equipment Division, in the Consumers' Hard Goods Bureau of the War Production Board, Washington, D. C., has joined the Hanson-Van Winkle-Munning Co., of Matawan, N. J.

DANIEL W. TALBOTT, recently plant superintendent of the Symington Gould Corporation, Rochester, N. Y., has been appointed general manager of the Cooper Alloy Foundry Co., Hillside, N. J.

S. C. BENNETT has joined the staff of the Lawrance Aeronautical Corporation, Linden, N. J., as chief engineer. He was formerly with the Bell Aircraft Corporation, Buffalo, N. Y.

New York

W. T. MCCARGO has been appointed eastern regional sales manager of the Carborundum Co., Niagara Falls, N. Y., succeeding F. JEROME TONE, JR., who has become vice-president in charge of sales. Mr. McCargo has been with the Carborundum Co. for a period of thirteen years, serving in the capacity of abrasive engineer.

W. T. McCargo, New Eastern Regional Sales Manager of Carborundum Co.

John D'Agostino, Recently Appointed South American Representative Simmons Machine Tool Corporation

JOHN D'AGOSTINO, until recently a member of the purchasing staff of the Brazilian Military Commission in Washington, has been appointed South American representative of the Simmons Machine Tool Corporation, Albany, N. Y. He will have headquarters at the offices of Simmons' South American agent, Mesbla S.A., Rua de Passeio No. 48, Rio de Janeiro, Brazil. He is a native Brazilian, but has been in the United States since 1928.

THE AMERICAN DIE CASTING INSTITUTE, 366 Madison Ave., New York 17, N. Y., has received the Distinguished Service Award of the Ordnance Department for "outstanding contributions to ordnance progress in the war." The award was presented at the annual meeting of the Institute at the Edgewater Beach Hotel, Chicago, Ill., on November 15. Since the American Die Casting Institute is not an engineering society, but a trade association, it is all the more significant that it should have been recognized for scientific and engineering accomplishments.

UNION CARBIDE AND CARBON CORPORATION announces the formation of a new Plastics Group within the organization to bring together the many activities that are related to the manufacture and sale of synthetic resins and plastic products. The Bakelite Corporation, 30 E. 42nd St., New York 17, N. Y., which has been a pioneer in the plastics industry, will carry on the integrated activities of the new Plastics Group.

UNITED STATES RUBBER CO., Rockefeller Center, New York City, has purchased the assets and business of the L. H. GILMER CO., Philadelphia, Pa., manufacturer of industrial V-belts. No change in the management or operations of the Gilmer company is contemplated. JOHN S. KRAUSS, president of the Gilmer organization, will continue in the active management of this business.

HERCULES ELECTRIC & MFG. CORPORATION, manufacturer of welding equipment and electrical accessories, is now located in a new plant at 256 Atlantic Ave., Brooklyn 7, N. Y., where the company has available the expanded facilities necessitated by an increased volume of business.

HERMAN A. EVERLIEN has been appointed general sales manager of the Mechanical Goods Division of the United States Rubber Co., Rockefeller Center, New York, N. Y. He has had more than forty years' experience in the mechanical rubber goods industry.

WILLIAM P. MICHELL has been appointed assistant chief engineer of Mack Trucks, Inc., Long Island City, N. Y. He became connected with the Mack organization in 1923 as a shop engineer, and was made assistant to the chief engineer in 1937.

AUSTIN F. PALMER, formerly superintendent of shell production, Eclipse Machine Division, Bendix Aviation Co., Elmira, N. Y., has joined the Gleason Machine Tool Co.'s New York City office as a sales engineer.

THOMAS I. SHRIVER has resigned as president of the V & O Press Co., Hudson, N. Y., to become chairman of the board of directors. HERMAN F. ZORN has been elected president to succeed Mr. Shriver.

INSTRUMENT PARTS CORPORATION, 141 Hudson St., New York 13, N. Y., has purchased a three-story factory building at Snowden Ave. and Water St., Ossining, N. Y., for the purpose of post-war expansion.

DEVENCO INCORPORATED, 150 Broadway, New York 7, N. Y., an organization of consulting technicians, has acquired additional engineering department facilities at 73 Warren St., New York City.

PAUL JAMES has been appointed district manager of the Syracuse office of the Lincoln Electric Co., Cleveland, Ohio. He will be located at 517 Erie Blvd., East, Syracuse, N. Y.

A. C. WEIGEL, vice-president of the Combustion Engineering Co., New York City, has been elected president of the American Welding Society.

E. L. HURST has been appointed field engineer for the Norton Co., Worcester, Mass., in the New York City and northern New Jersey territory.

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MACHINERY'S DATA SHEETS 527 and 528

ELECTRONIC CONTROL "TROUBLE-SHOOTING" CHART—1

General Items for All Types of Electronic Control

Trouble	Cause	Remedy
Loose connection or lead breakage	Excessive vibration	Install extra flexible connections.
Mercury-vapor tubes do not "fire"	Ambient temperature too low	Measure air temperature next to tube; provide heat to bring temperature up to value specified in tube instructions. Manually or thermostatically controlled strip heaters are recommended.
Reduced tube life or tube failure	Vibration or mechanical abuse	Shock-mount the control panel and use extra flexible leads. Prevent objects from striking tube-holders and sockets. Elements may be jarred out of position or the weld on leads may be broken.
WARNING—*Tube filament or heater circuits may be at high voltage above ground. Use extreme care in making measurements and adjustments.*	Natural deterioration (Usually failure is due to gradual loss of electron emission as the active cathode material is used up or flakes off.)	Be sure deterioration is at a rate consistent with expected life for each type of tube in its particular service. If the tube life seems too short, see following recommendations.
	Incorrect voltage on filament or heater	Check voltage at tube terminals frequently to determine nature of error. Do this with tube in socket, both with and without anode load connected.
	If voltage is: Fluctuating (more than plus or minus 5 per cent from rating)	Install voltage regulating transformer.
	Consistently high or consistently low	Adjust taps (if any) on transformer, or install new heater transformer, or install auto or booster transformer to correct voltage.

Compiled by the General Electric Co. Schenectady, N. Y.

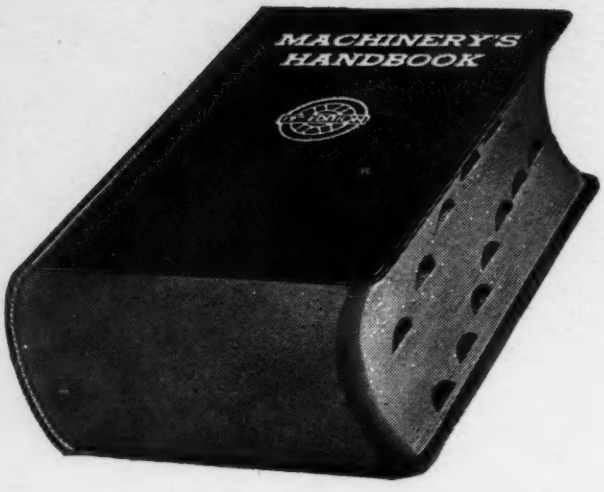
ELECTRONIC CONTROL "TROUBLE-SHOOTING" CHART—2

General Items for All Types of Electronic Control

Trouble	Cause	Remedy
Reduced tube life or tube failure (continued from Data Sheet No. 527)	If voltage is erratic—on and off	Check wiring from heater supply to tube sockets for loose connection or break.
	Ambient temperature too low or too high	Provide extra heat or forced air cooling to hold temperature within limits specified in tube instructions. Ambient temperature should be measured at the tube. Consult tube instruction sheet before applying cooling means.
WARNING—*Tube filament or heater circuits may be at high voltage above ground. Use extreme care in making measurements and adjustments.*	Excessive loading. (Operators may have increased anode voltage, replaced coils, or made other changes to obtain greater output.)	Tube should not be operated at outputs greater than those for which it has been designed.
	Too frequent operation	When equipment is used intermittently, tube life can be increased by leaving cathodes heated during unloaded periods. This prevents strains caused by too frequent heating and cooling.
Arc-backs after tubes have warmed up	Ambient temperature too high	Provide forced air cooling according to instruction sheet on tubes. (Mercury-vapor tubes are rated on the basis of "condensed mercury temperature.")
Arc-backs when tubes are first placed in service	Mercury vapor splashed on elements during shipment or handling of tubes. Tubes not kept in upright position.	Heat the tube cathode to distill this mercury before anode power is applied. Make sure cathode is heated for the length of time stipulated in instructions furnished with tubes.

Compiled by the General Electric Co. Schenectady, N. Y.

MACHINERY'S HANDBOOK



The "Bible" of the Mechanical Industry

MACHINERY'S Handbook contains 1815 pages of mechanical tables, rules, formulas and general data needed wherever machines, tools or other mechanical appliances are designed and constructed. It is reliable, complete, and simple in arrangement, and is full of standard data and thoroughly practical information.

Shop men, as well as engineers and designers, find MACHINERY'S Handbook invaluable. It contains the kind of information that is required every day in manufacturing and designing departments.

Price $6—
payable $2 with order,
$2 monthly if desired.

THE INDUSTRIAL PRESS, 148 Lafayette Street, New York 13, N. Y.

THE USE OF HANDBOOK TABLES AND FORMULAS

A companion book which shows you how to get the most out of MACHINERY'S HANDBOOK

This companion book, which costs only $1, serves three purposes: It throws the spotlight on a lot of essential time-saving tables, rules and general information in MACHINERY'S Handbook that the ordinary user never discovers.

A second and equally important function is to show by examples, solutions and test questions, typical applications of handbook matter in both drafting rooms and machines shops. A third object is to provide test questions and drill work designed for use in technical schools and machine-shop training courses so that students will learn at the outset how to apply an engineering handbook.

203 Pages, 63 Illustrations, 500 Problems, Exercises, Test Questions,
Price $1; with MACHINERY'S HANDBOOK, $7.

THE INDUSTRIAL PRESS, 148 Lafayette Street, New York 13, N. Y.

Ohio

S. L. EASTMAN has been appointed chief engineer of the Cleveland Worm & Gear Co., Cleveland, Ohio. Mr. Eastman has been connected with the company in various capacities since graduating from the Case School of Applied Science in 1927. Since April, 1942, he has held the position of assistant chief engineer.

S. L. Eastman, Recently Appointed Chief Engineer of Cleveland Worm & Gear Co.

THEODORE S. BONNEMA, formerly production manager of the Oster Mfg. Co., Cleveland, Ohio, has been appointed vice-president in charge of production. LESTER D. MARTIN, previously comptroller, has been made treasurer. Both have been with the company for more than twenty years in various capacities.

CLARENCE L. COLLENS, for thirty-seven years president of the Reliance Electric & Engineering Co., Cleveland, Ohio, has been elected to the newly created post of chairman of the board, and is succeeded in the presidency by JAMES W. COREY, sales vice-president since 1940. H. M. HITCHCOCK, senior vice-president and treasurer of the company, has resigned and will be succeeded as senior vice-president by A. M. MACCUTCHEON, engineering vice-president. C. V. PUTNAM, who has been with the company for thirty-eight years, is also resigning for reasons of health. His office of secretary will be filled by ROSCOE H. SMITH, who will also continue his duties as head of the sales promotion department.

GEORGE S. EATON was named executive secretary of the National Tool and Die Manufacturers Association at a recent meeting of the board of directors. It was voted at this meeting to discontinue the title of general manager. Announcement was also made of the transfer of the offices from Washington, D. C., to the Union Commerce Bldg., Cleveland, Ohio.

W. A. SMITH has been appointed manager of suspension sales of the Industrial Products Sales Division of the B. F. Goodrich Co., Akron, Ohio. Among other products, he will handle the company's Vibro insulators — devices of rubber and metal used for isolating vibration and noise. Mr. Smith has been with the company since 1924.

JOHN P. FLEMING has been appointed general manager of the Barium Steel Corporation, Canton, Ohio. Mr. Fleming has been associated for the last fourteen years with the American Locomotive Works, Schenectady, N. Y.

H. E. GROUT, manager of manufacturing, has been placed in complete charge of all small motor factory operations at the Lima Small Motor Division, Lima, Ohio, of the Westinghouse Electric & Mfg. Co.

Theodore S. Bonnema, Vice-president in Charge of Production, Oster Mfg. Co.

Lester D. Martin, Newly Appointed Treasurer of the Oster Mfg. Co.

Pennsylvania

DR. R. A. LINCOLN has been appointed metallurgical engineer and associate director of research of the Stainless Steel Division of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. Dr. Lincoln has been connected with the company's research laboratory at Brackenridge, Pa., since 1935.

DR. GURDON M. BUTLER has been appointed metallurgical engineer and associate director of research of the Tool and Die Steel Division of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. Dr. Butler has been research metallurgist at the company's Dunkirk, N. Y., plant since 1937.

GEORGE C. KIEFER, who has been associated with the Allegheny Ludlum Steel Corporation at the Brackenridge, Pa., plant since 1916, has been made chemical engineer and associate director of research of the company's Corrosion and Coatings Division.

R. C. WILLEY has been appointed abrasive engineer in Pittsburgh, Pa., by the Norton Co., Worcester, Mass. RALPH E. RASMUSSEN will assume Mr. Willey's former position as office manager of the Norton warehouse in Pittsburgh.

RICHARD S. JOHNSON has joined the Philadelphia Division of the Yale & Towne Mfg. Co., Philadelphia, Pa., as research engineer. He was for ten years chief engineer of the International Chain Co. of York, Pa.

A. F. DOBBRODT has been appointed Pittsburgh district manager of CARBOLOY COMPANY, INC., with headquarters at 704 Second Ave., Pittsburgh, Pa.

Washington, D. C., and Texas

ANDREW R. BENEDICTUS, of Brussels, Belgium, has recently joined the engineering service of the Foreign Economic Administration in Washington. Mr. Benedictus who has had fifteen years extensive experience in the machine tool and production engineering fields was called to the former Board of Economic Warfare two years ago. Since then he has been active in several divisions of both that agency and its successor, the Foreign Economic

Administration. Mr. Benedictus' present activities are those of principal mechanical engineer in assisting the shaping of over-all production policies in connection with the metal-working industries outside the United States. Before the invasion of Belgium, Mr. Benedictus was director of Etablissement Henri Benedictus of Brussels.

GEORGE L. WILEY has joined the Big Three Equipment Co. at Houston, Tex., as welding consultant. The company is Texas distributor for the Lincoln Electric Co., Cleveland, Ohio.

Wisconsin

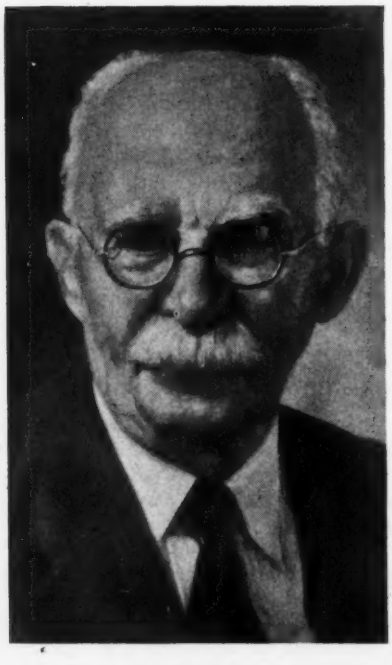
RALPH M. HINCKLEY has been appointed abrasive engineer in the Milwaukee, Wis., territory by the Norton Co., Worcester, Mass. Mr. Hinckley was formerly grinding wheel specialist with the John Pritzlaff Hardware Co., Norton distributor in Milwaukee.

GEORGE F. FARLEY has been elected vice-president in charge of sales for Spincraft (Milwaukee Metal Spinning Co.), Milwaukee, Wis.

Obituaries

James L. Lucas

James L. Lucas, founder and retired president of J. L. Lucas & Son, Inc., Bridgeport, Conn., died October 19 at Coral Gables, Fla., after an attack of pneumonia. He was eighty-nine years old.



James L. Lucas

Mr. Lucas was born in North Carver, Mass., and went to Bridgeport in 1895. He was first associated with the Bridgeport Brass Co. and the American-British Ordinance Co., and later became superintendent of the Locomobile Co. of America. In 1905, he started his own business for the manufacture of machinery and automobile parts. In 1940, when the present plant in Fairfield, Conn., was built, Mr. Lucas remained as president until 1942, when he retired, his son, Frank B. Lucas, becoming the head of the organization. Mr. Lucas has been a contributor of articles to the technical press and is the author of the book "Dies and Diemaking."

He is survived by his wife, Helen E. Lucas, a son, Frank B. Lucas, four grandsons and two granddaughters, as well as five great-grandchildren.

Nicodemus Bosch

Nicodemus Bosch, president and general manager of the Western Machine Tool Works, Holland, Mich., for forty years, died in the Holland Hospital on October 22 at the age of eighty-one years. Mr. Bosch was born on a farm near Vriesland, Mich. He attended Hope College and a business college in Grand Rapids, and after having been employed for eight years in the business department of one of the local firms, he bought an interest in a small machine repair shop. With two associates he organized the Valley City Machine Works in Grand Rapids, and in 1902 he joined John Boda in the incorporation of the Western Machine Tool Works in Holland. He moved to Holland in 1905, and continued as president of the company until his death, having, in 1919, bought out the Boda interests.

Mr. Bosch was also active in civic affairs, having served for ten years as mayor of Holland, first from 1912 to 1916, again from 1918 to 1920, and for the third time from 1932 to 1936.

His company was engaged in producing machine tools in both World Wars, and was honored in 1943 with the award of the Army-Navy "E" production pennant for "high achievement in production of war materiel." Since then, at six-month intervals, the company has been awarded two additional white stars.

Mr. Bosch was one of the men in the mechanical industry who had been engaged in that field for over fifty years, and who, on the occasion of MACHINERY'S fiftieth anniversary, was recognized for his "contribution to the remarkable development of the mechanical industry during the past half century, a development that has laid the foundation and produced the means for industrial progress and material prosperity, and that now, in the war emergency, has risen to new heights in war production achievement."

Nicodemus Bosch

Mr. Bosch is survived by his widow, two daughters, three sons, and fourteen grandchildren. Two of the sons, Gerald J. and Randall C. Bosch, have been associated with their father in executive capacities in the business for a number of years.

J. W. Sullivan

J. W. Sullivan, chairman of the board of Skilsaw, Inc., died on October 26 at his home in Evanston, Ill., aged seventy-three years. Mr. Sullivan was founder of Skilsaw, Inc., portable electric tool manufacturers. During the early years of the company, he devoted all of the daylight hours to calling on contractors and convincing them of the value and possibilities of the first portable electric hand saw. His first major sales success was in supplying Skilsaws to construction companies who built the American Furniture Mart and Chicago's Wacker Drive. At night he supervised the "production" line in the company's factory.

Mr. Sullivan became president of Skilsaw, Inc., in 1926, and was elected chairman of the board in 1942, when his son, Bolton Sullivan, was appointed president of the company. Up to a short time before his death, Mr. Sullivan was an active force in directing the company's production and sales policy, and contributed much toward friendly employer-employe relations.

JOSEPH S. PENDLETON, secretary-treasurer of the Carpenter Steel Co., Reading, Pa., died on October 7 following a heart attack. Mr. Pendleton became connected with the Carpenter organization in 1897 as assistant chemist. He became assistant manager in 1906, assistant treasurer in 1914, treasurer

COMPLETE POWER UNIT

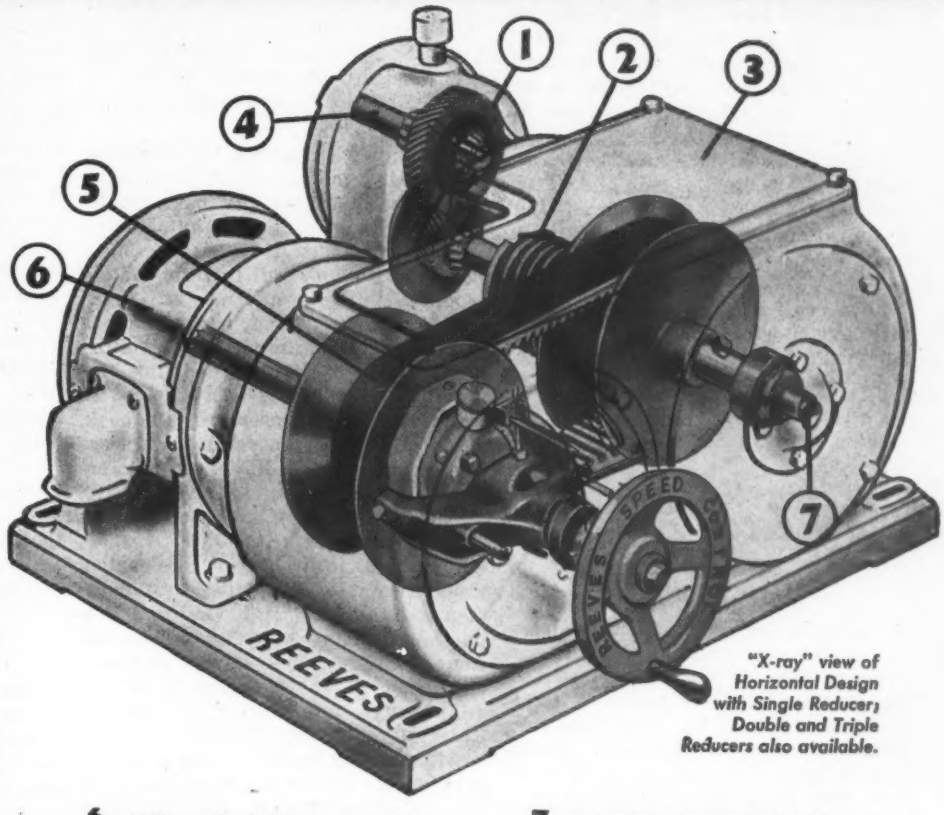
1. HELICAL TYPE GEAR REDUCER provides quiet transmission of gear load, better load distribution, longer life. Two or more angle-cut teeth in constant contact across gear face.

2. TENSION SPRING mounted on variable speed shaft, holds V-belt positively and automatically against disc faces. Makes it possible to secure maximum tension on belt at maximum speed, when maximum h.p. is required on unit and machine.

3. ACCESSIBILITY TO OPERATING PARTS OF REEVES MOTODRIVE is quick and easy. Simply remove four cap screws from cover plate. Removal and replacement of V-belt is readily accomplished.

4. OUTPUT variable speed shaft may be extended on either side of case—with or without reducer. A great convenience where wall, post or other obstacle might otherwise interfere; 13 different assemblies as to positions of motor, handwheel, shaft extension and reducer.

5. V-BELT is strong, endless cord construction, and held to minimum thickness to assure cool running and longer life. Very flexible, practically stretchless, of high tensile strength, evenly balanced in weight for proper load distribution. Transmits power smoothly and positively—without fluctuation or slippage.



"X-ray" view of Horizontal Design with Single Reducer; Double and Triple Reducers also available.

6. ANY standard foot-type, constant speed, ball-bearing motor may be used. Also several flange type motors.

7. CONVENIENT LUBRICATION—All operating parts lubricated through six force-feed fittings and 1 cup-type.

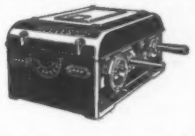
REEVES Motodrive

Motor Plus Variable Speed Plus Gear Reducer in one Compact, Enclosed Unit

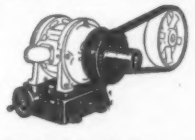
Output speeds from 1.35 to 3480 r.p.m. may be secured with the REEVES Motodrive through the many different combinations of sizes, speed ratios and reduction gears available. Thus this modern, totally enclosed, compact unit meets practically all requirements for variable speed within 15 h.p. capacities. Widely used on machines where space is limited or where direct connection between motor and machine is desirable. Takes any standard foot-type, constant speed motor. Like all REEVES units, the Motodrive is simple, rugged, accurate. Transmission of power is absolutely positive at all speeds. Handwheel or Electric Remote Control. Space-saving vertical and horizontal designs. Easily applied to any driven machine. Write for Catalog M-441, giving full information.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

The Two Other Basic Reeves Units



VARIABLE SPEED TRANSMISSION for providing infinite speed regulation over wide range—2:1 to 16:1. Sizes fractional to 87 h.p.



VARI-SPEED MOTOR PULLEY converts any constant speed motor to a variable speed drive within 4:1 ratio. Sizes to 15 h.p.

REEVES Accurate Variable Speed Control

in 1916, and secretary in 1917. He was also a director of the company, as well as a director of the American Mutual Liability Insurance Co. and the American Policyholders Insurance Co.

GEORGE H. PRATT, of South Glastonbury, Conn., who was sales manager of the Cushman Chuck Co., Hartford, Conn., for twenty years prior to his retirement in 1937, died on October 21.

J. J. LARKIN, president of the Larkin Packer Co., St. Louis, Mo., and of the Davis Boring Tool Division of that organization, died at his home in St. Louis on October 23.

ROWLAND RIEHL, general manager of the Davis Boring Tool Division of the Larkin Packer Co., St. Louis, Mo., died at his home in that city on October 22.

Coming Events

DECEMBER 6-8—Forty-ninth CONGRESS OF AMERICAN INDUSTRY under the auspices of the National Association of Manufacturers at the Waldorf-Astoria Hotel, New York City. For further information, address National Association of Manufacturers, 14 W. 49th St., New York 20, N. Y.

JANUARY 8-12—Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book-Cadillac Hotel, Detroit, Mich. Further information can be obtained from John A. C. Warner, secretary and general manager, 29 W. 39th St., New York 18, N. Y.

MARCH 19-22 — MACHINE AND TOOL PROGRESS EXPOSITION under the auspices of the AMERICAN SOCIETY OF TOOL ENGINEERS, to be held in the Cleveland Auditorium, Cleveland, Ohio. Adrian L. Potter, executive secretary, 1666 Penobscot Building, Detroit 26, Mich.

MARCH 19-22—Annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS in Cleveland, Ohio. Adrian L. Potter, executive secretary, 1666 Penobscot Building, Detroit 26, Mich.

APRIL 4-6—National Aeronautic Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Hotel New Yorker, New York City. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York 18, N. Y.

APRIL 30-MAY 4—Forty-ninth annual meeting of the AMERICAN FOUNDRYMEN'S ASSOCIATION in Detroit, Mich. For further information, address American Foundrymen's Association, 222 W. Adams St., Chicago 6, Ill.

New Books and Publications

PRODUCTION HANDBOOK. Edited by the late Dr. L. P. Alford and John R. Bangs. 1676 pages, 5 by 7 1/4 inches. Profusely illustrated. Published by the Ronald Press Co., 15 E. 26th St., New York 10, N. Y. Price, $7.50.

This handbook covers the problems of directing men, dealing with materials, and obtaining the best results from machines in the manufacturing establishment. It discusses the most effective methods of turning out a product, living up to time schedules, meeting the requirements of budgets and costs, and planning and controlling production. It is designed for the practical daily use of men engaged in manufacturing. In preparing the book, one of the important groups of users has also been kept in mind—the oncoming younger men in our factories.

The plan of this handbook follows the lines laid out by the late Dr. L. P. Alford and incorporates his earlier experience as editor of both. "Management's Handbook" and "Cost and Production Handbook." The work was completed by John R. Bangs, professor and head of the department of administrative engineering at Cornell University. George E. Hagemann has assisted as staff editor in the production of the book. No section of the handbook has been produced by any one individual, a large number of contributing editors having produced the chapters pertaining to their particular fields.

The handbook covers the following main sections: Plant Organization; Production Planning and Control; Production Control Systems; Purchasing; Materials Control and Standardization; Storeskeeping; Time Study and Operation Analysis; Motion Study — Work Simplification; Inspection; Quality Control; Plant Lay-out; Machinery; Tools, Jigs, and Fixtures; Materials Handling; Job Estimating; Job Evaluation; Merit Rating; Wage Plans; Plant Maintenance; Classifications and Symbols; Principles of Management; Measures of Performance; Manufacturing Costs; Factory Budgets; and Plant Personnel.

FERROUS METALLURGY (VOLUME III). By Ernest J. Teichert. 577 pages, 5 1/4 by 8 1/2 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $5.

This the third volume of a treatise on ferrous metallurgy, the present book, which is in its second edition, dealing with metallography and the heat-treatment of steel. This complete work offers an opportunity for the employe in iron and steel to acquire a working knowledge of fundamental technical metallurgy. The author was formerly supervisor of metallurgy extension at the Pennsylvania State College. The present volume includes information on the latest heat-treating equipment and practice. An idea of the contents will be obtained by the following list of chapter heads: Microscopy; The X-Ray; The Physical Testing of Metals; Constitution of Metallic Alloys; The Iron-Carbon Diagram; The Metallography of Steel Castings and Cast Iron; The Mechanical Treatment of Steel; The Heat-Treatment of Plain Carbon Steels; Precipitation Hardening; Grain Size in Steel; The Heat-Treatment of Steel Castings; Casehardening of Steels; Alloy Steels; Individual Effects of Alloying Elements; S A E Alloy Steels; Factors Affecting the Selection of Steels; Special Alloy Steels; and Cast Irons and Their Treatment.

PRINCIPLES OF MODERN INDUSTRIAL ORGANIZATION. By Walter Rautenstrauch. 312 pages, 6 by 9 inches. Published by the Pitman Publishing Corporation, 2 W. 45th St., New York 19, N. Y. Price, $3.75.

This book has been prepared for the use of students who are beginning an inquiry into the problems of industrial organization and for executives in industry who wish to review the principles of organization as applied to manufacture. Particular emphasis has been placed on the methods of analysis by which the activities of each department of a manufacturing establishment may be studied, evaluated, and improved. Briefly, the book deals with the organization of unit operations; the organizing of the flow of work; procedure in organizing a plant; planning, scheduling, and despatching; design problems; storekeeping; sales; purchasing; plant engineering and maintenance; measurement and control of operations; economics of the operations; and procedure in reorganization.

A.S.M.E. MECHANICAL CATALOG AND DIRECTORY (1945). 711 pages, 9 by 11 1/2 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

This is the thirty-fourth annual volume of the "A.S.M.E. Mechanical Catalog." The new volume shows a continued growth. The 300-page classified list of products is expanded and revised. It is divided into four distinct sections: Catalogues containing descriptions of hundreds of items used by industry in manufacturing and maintenance; a directory indicating the source of equipment, machinery, and supplies; an alphabetical list of

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trade names; and a 16-page section giving information about codes, standards, periodicals, etc., published by the American Society of Mechanical Engineers. The book is a most useful tool to any buyer of mechanical equipment.

MANUAL OF MACHINE SHOP PRACTICE. By Otis Benedict, Jr. 249 pages, 5 by 7 1/2 inches; 155 illustrations. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $1.75.

The aim of the author of this book, who is assistant professor of the department of shop practice at Pratt Institute, Brooklyn, N. Y., is to present material that will be helpful to the student pursuing a course in engineering shop practice. It was not the author's intention to write another book on machine tool operation, and in the preface, he points out that on account of the wide diversity of the material presented there must be some lack of continuity. The subjects covered include chisels, files, cutting speeds, machining time, screw threads, tapers, tolerances and allowances, precision measuring devices, press tools, standard die sets, etc.

MACHINE DESIGNERS' GUIDE. By K. W. Najder. 281 pages, 5 1/2 by 8 1/2 inches. Published by Machine Designers' Guide, Lake Orion, Mich. Price, $2.75.

This is the third edition of a book containing formulas pertaining to mechanics and strength of materials, the first edition having been published in 1935. Briefly, the book covers tables, construction of curves, principles and formulas in mechanics, graphics, and the strength of materials, including simple and combined stresses and the strength of plates and cylinders. These sections are followed by one giving numerous examples of problems solved by the use of the rules and formulas given.

SIMPLIFIED TIME STUDY. By Herbert J. Myers. 140 pages, 5 1/2 by 8 1/2 inches. Published by the Ronald Press Co., 15 E. 26th St., New York 10, N. Y. Price, $2.50.

This book has been prepared for factory supervisors, shop stewards, and cost men. Its object is to make the subject of time study as clear and simple as possible. Consequently, the text has not been complicated by too much technical detail. Briefly the book covers such subjects as time study equipment, first steps in making a time study, time studies of machine operations, time study calculations, accumulation of basic data for future use, and the using of basic time standards.

THE THEORY AND PRACTICE OF JOB RATING. By M. F. Stigers and E. G. Reed. 168 pages, 5 by 7 1/2 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $1.75.

This is the second edition of a book dealing with a subject that has become more and more important during recent years. Numerous additions have been made to the second edition, bringing it up to date. It should prove useful to anyone requiring a knowledge of job rating procedure.

GLOSSARY OF FOREIGN WELDING TERMS. 16 pages, 6 by 9 inches. Published by the American Welding Society, 33 W. 39th St., New York 18, N. Y. Price, 50 cents.

This glossary contains a list of welding terms in German, French, Russian, and Spanish. It will serve to supplement standard or engineering dictionaries in which some of these terms are lacking.

AIRCRAFT SHEET-METAL BLUEPRINT READING. By Harry H. Coxen, Gerald E. Jackson, and Gilbert D. Masters. 131 pages, 8 1/2 by 11 inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago 37, Ill. Price, $2.50.

SCREW MACHINE PRODUCTS DATA BOOK FOR POST-WAR PLANNING. 23 pages, 8 1/2 by 11 inches. Published by the Eastern Machine Screw Corporation, New Haven, Conn. Price, 15 cents.

THE ANNEALING OF STEEL. By Peter Payson. 59 pages, 5 1/8 by 8 1/8 inches. Distributed by the Crucible Steel Co. of America, 405 Lexington Ave., New York 20, N. Y. Price, $1.

OPERATING AN ENGINE LATHE. By Ray S. Lindenmeyer. 64 pages, 6 by 9 1/4 inches. Published by Science and Mechanics, 154 E. Erie St., Chicago 11, Ill. Price, 50 cents.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933,

of MACHINERY, published monthly at New York 13, N. Y., for October 1, 1944.

State of New York }
County of New York } ss.

Before me, a Notary Public in and for the state and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the treasurer of The Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

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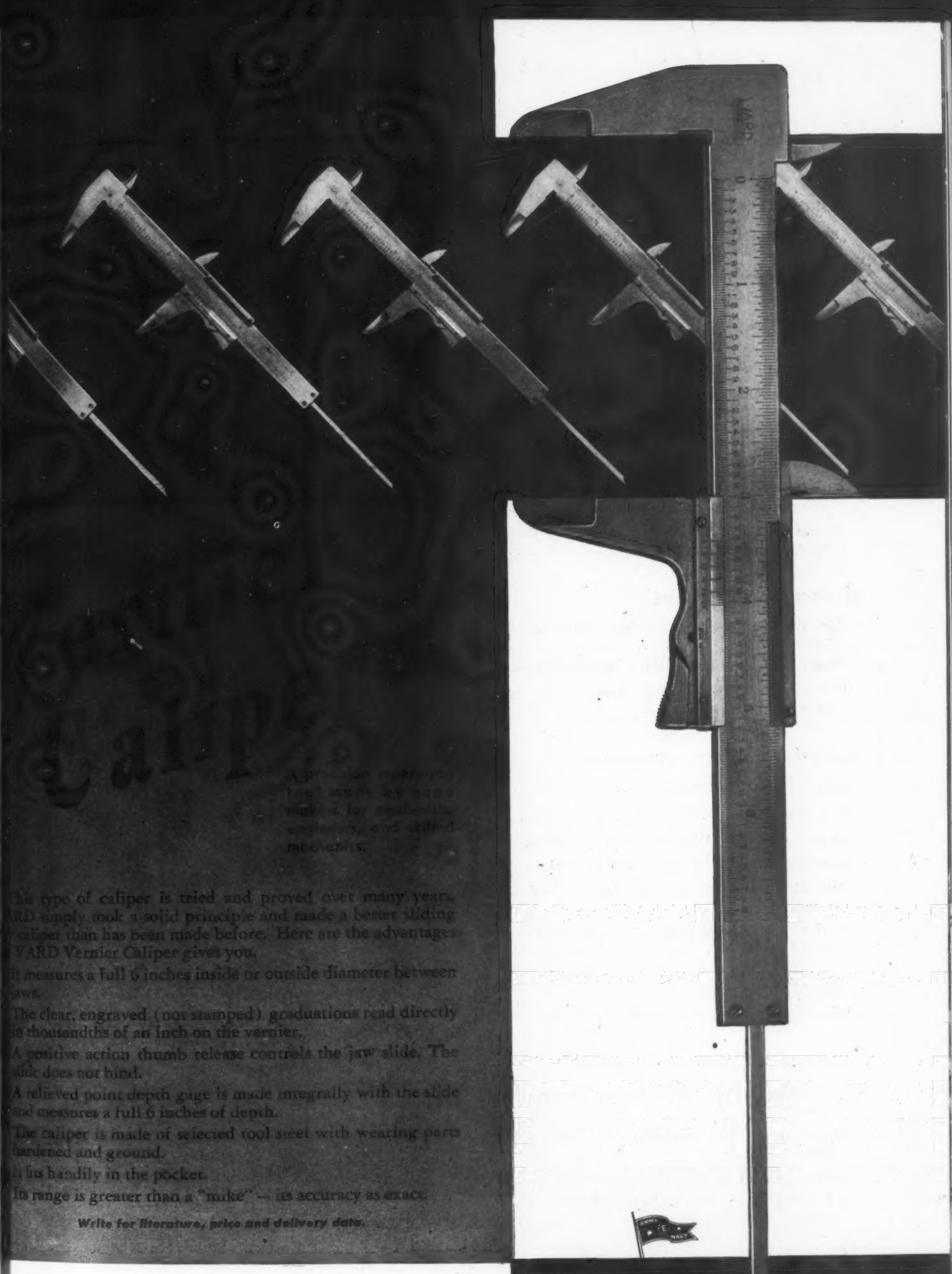

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